ENGINE PERFORMANCE TESTING AND SERVICE

Student Workbook

FRANK B. KELLOGG HIGH SCHOOL
15 E. CO. RD. B2
ST. PAUL, MINNESOTA 55117

Sun ELECTRIC CORPORATION

Second Edition

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ENGINE PERFORMANCE AND TESTING QUIZ

1. The basic function of valve overlap is:

   A. To prevent valve burning
   B. To improve volumetric efficiency
   C. To provide smoother idle
   D. To provide easier starting

2. How many crankshaft revolutions are required to complete one engine cycle in a four stroke cycle engine?

   A. One
   B. Two
   C. Three
   D. Four

3. To fire all of the cylinders in an eight cylinder four stroke cycle engine once, the crankshaft must complete:

   A. One revolution
   B. Two revolutions
   C. Four revolutions
   D. Sixteen revolutions

4. Cranking vacuum test indicates the condition of the:

   A. Charging system
   B. Carburetor and fuel pump
   C. Mechanical condition of the engine
   D. Vacuum diaphragm

5. Four factors that determine the electrical resistance of a length of wire are:

   A. Cross section, insulation, material, and diameter
   B. Temperature, length, material, and insulation
   C. Material, length, cross section, and temperature
   D. None of the above

6. Voltage drop is:

   A. Battery open circuit voltage between full charge and discharge
   B. Voltage expended in pushing a current through a resistance
   C. Another term for a short circuit
   D. Another term for an open circuit

7. How many sparks per minute occur at #1 spark plug at 1000 crankshaft rpms on an eight cylinder four stroke cycle engine?

   A. 250
   B. 500
   C. 1000
   D. 2000

8. The voltage normally encountered by an ignition condenser when the distributor breaker points open is approximately:

   A. 6 volts
   B. 250 volts
   C. 4000 volts
   D. 14,000 volts

9. An ammeter is placed in a circuit in:

   A. Series
   B. Parallel
   C. Shunt
   D. Parallel shunt

10. Ignition voltage requirements are:

    A. Highest with lean mixture
    B. Highest with rich mixture
    C. Lowest with lean mixture
    D. Mixture does not affect voltage requirements

11. A distributor rotor tip that is changed in shape by being burned:

    A. Will advance timing
    B. Will retard timing
    C. Affects timing only at high speed
    D. Will not affect timing

12. Which condenser stores the greater amount of electrical energy?

    A. .100 microfarad
    B. .32 microfarad
    C. .25 microfarad
    D. .5 microfarad

13. A five degree change in dwell will cause a change in ignition timing of:

    A. 2½ degrees
    B. 5 degrees
    C. 10 degrees
    D. No change will occur

14. As the rubbing block on the contact points wears:

A. Dwell angle increases and point gap increases
B. Dwell angle increases and point gap decreases
C. Dwell angle decreases and point gap increases
D. No change occurs

15. For efficient ignition system operation, the polarity of the secondary ignition circuit should be:

A. Positive ground
B. Negative ground
C. Alternately negative and positive
D. Does not affect ignition efficiency

16. During the cranking operation, a 12 volt battery should be able to maintain at least:

A. 12.6
B. 9.8
C. 9.6
D. 8.9

17. Voltage is:

A. Electrical pressure
B. A unit of electrical horsepower
C. A unit of resistance
D. Caused by eddy current

18. An Ohm is a measurement of:

A. Electrical pressure
B. Electrical flow
C. Electrical resistance
D. Electrical capacity

19. To properly adjust initial (basic) ignition timing what two instruments are needed?

A. Timing light
B. Vacuum gauge
C. Distributor tester
D. Tachometer

20. Frayed or worn conductor insulation will cause high resistance in:

A. Primary circuit
B. Secondary circuit
C. Any electrical circuit
D. No electrical circuit

21. Fuel pumps may be checked for:

A. Volume
B. Pressure
C. Vacuum
D. All of the above

22. Carburetor idle mixture should be adjusted ________________ the ignition timing has been set.

A. Before
B. After
C. Makes no difference
D. While

23. A cracked intake manifold may cause:

A. Rich mixture
B. Noticeable drop in oil pressure
C. Lean mixture
D. No change

24. The intermediate section of the scope pattern indicates the condition of the:

A. Spark plugs
B. Coil and condenser
C. Ballast resistor
D. Ignition points

25. Too much valve tappet clearance will cause valves to:

A. Open late and close late
B. Open early and close late
C. Open late and close early
D. Open early and close early

26. Five areas of engine testing are:

A. Starting, charging, carburetor, fuel, ignition
B. Battery, starting, charging, ignition, fuel
C. Battery, starting, charging, ignition, compression
D. Starting, compression, fuel, ignition, charging

27. Breaker points are aligned by bending the:

A. Movable points arm
B. Movable points arm pivot post
C. Stationary point bracket
D. Is not adjustable

28. Low breaker point spring tension will result in:

A. Point bounce
B. Increased dwell
C. Decreased point gap
D. Point float

29. Distributor centrifugal (mechanical) advance action is governed by:

A. The speed of the engine
B. Engine vacuum
C. The breaker point gap
D. The engine load conditions

30. Distributor vacuum advance action is governed by:

A. The number of cylinders in the engine
B. Breaker plate movement
C. The load of the engine
D. The speed of the engine

31. A faulty valve in the positive crankcase ventilation system will:

A. Affect idle stability
B. Decrease exhaust emissions
C. Increase gasoline mileage
D. All of the above

32. Radio and TV suppression type resistor spark plug cables:

A. Increase the voltage required to fire the spark plugs
B. Are used only with resistor type spark plugs
C. Must be carefully handled to avoid internal cable damage
D. Must have more than 100,000 ohms resistance to be considered satisfactory

33. Fuel pump pressure is controlled by the:

A. Speed of the engine
B. Size of the pump
C. Tension of the diaphragm spring
D. Length of diaphragm stroke

34. Coil output is maximum while running the engine when the:

A. Secondary circuit is opened by disconnecting a plug wire
B. Rotor is shorted
C. Spark plugs are fouled
D. Plug wire is grounded with a test prod

35. When operating under a heavy load or wide open throttle, the power system of a carburetor must be able to supply:

A. Leaner mixtures
B. More vacuum
C. Richer mixtures
D. More pressure

36. A typical 12 volt charging system voltage limiter should be adjusted for a operating voltage of:

A. 12 volts
B. 12.0 - 12.5
C. 12.5 - 13.5
D. 13.5 - 15.3

37. The carburetor operates on the principle of:

A. Atmospheric Pressure
B. Fuel pump pressure
C. Differential pressure
D. Positive pressure

38. Which is part of the primary ignition circuit?

A. Breaker points
B. Distributor cap
C. Distributor rotor
D. Spark plugs

39. Excessive drop in dwell as distributor speed is increased may indicate:

A. Point bounce
B. Point float
C. Poor condenser ground
D. A and B

40. Ignition condensers should be checked for:

A. Current draw, molecular capacity, parallel resistance
B. Electrical capacity, electrical leakage, parallel resistance
C. Electrical capacity, series resistance, electrical leakage
D. Electrical capacity, parallel resistance, current draw

NAME____________________

DATE____________________

ENGINE PERFORMANCE AND TESTING QUIZ
ANSWER SHEET

No. right________

1. A B C D
2. A B C D
3. A B C D
4. A B C D
5. A B C D
6. A B C D
7. A B C D
8. A B C D
9. A B C D
10. A B C D
11. A B C D
12. A B C D
13. A B C D
14. A B C D
15. A B C D
16. A B C D
17. A B C D
18. A B C D
19. A B C D
20. A B C D
21. A B C D
22. A B C D
23. A B C D
24. A B C D
25. A B C D
26. A B C D
27. A B C D
28. A B C D
29. A B C D
30. A B C D
31. A B C D
32. A B C D
33. A B C D
34. A B C D
35. A B C D
36. A B C D
37. A B C D
38. A B C D
39. A B C D
40. A B C D

ENGINE PERFORMANCE AND TESTING QUIZ
CORRECT ANSWERS

1. B
2. B
3. B
4. C
5. C
6. B
7. B
8. B
9. A
10. A
11. D
12. D
13. B
14. B
15. A
16. C
17. A
18. C
19. A - D
20. D
21. D
22. B
23. C
24. B
25. C
26. D
27. C
28. D
29. A
30. C
31. A
32. C
33. C
34. A
35. C
36. D
37. C
38. A
39. B
40. C

TWO QUESTION SURVEY

QUESTION NO. 1

What steps or procedures do you now perform for a complete tune up? List these steps below.

QUESTION NO. 2

What tests would you perform to find the cause of a hesitation in acceleration? List these tests below.

THE NEW SUN SERVICE CONTROL SYSTEM

A
BETTER WAY
TO COMMUNICATE

Sun's New Service Control Puts It In Writing...

...for the Car Owner.

Easy-to-understand Service Guides enable the customer to choose from a complete list of basic services. They make it possible to communicate what is wanted done to the family car. There's no room for misunderstandings. The customer will leave with the assurance that all services selected will be taken care of.

...for Service Management.

When it comes to specifying maintenenc and repair work on the repair order, he is now in position to let the customer decide what kind of service he or she expects.

System

...for the Line Mechanic.

en he starts work on the car, he knows ctly what maintenance or repair work the customer expects. The repair order leaves nothing to doubt. It eliminates wasted time checking back with the service writer.

Sun's New Service Control System consists of service-selling guides that define the services you offer to make sure your customers' cars perform the way they're expected to.

Displayed in your place of business, these guides literally invite your customers to choose from a complete "Menu" of your services.

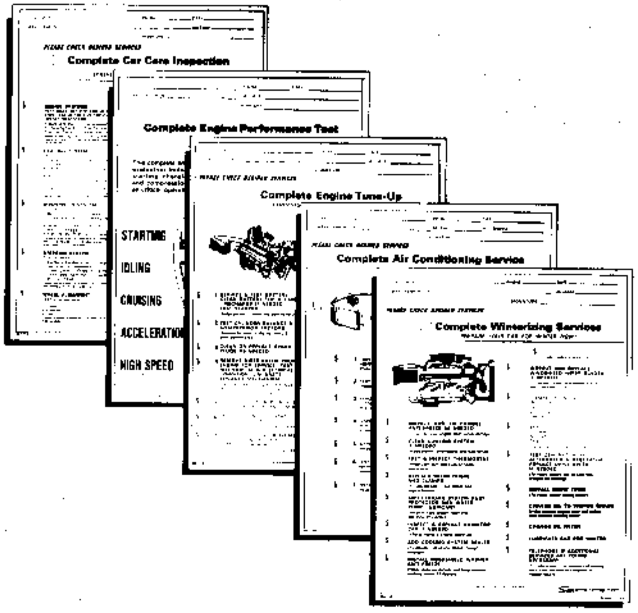
Once filled in, they communicate to your service writers and mechanics exactly what services the customer expects your shop to perform.

The system is that simple. But the results are dramatic:

- **Faster, more complete service write-up**
- **Specific repair orders**
- **More productivity and profitability on the same volume of cars**
- **Increased shop efficiency**
- **Greater shop absorption**
- **More showroom business**
- **Improved owner relations**

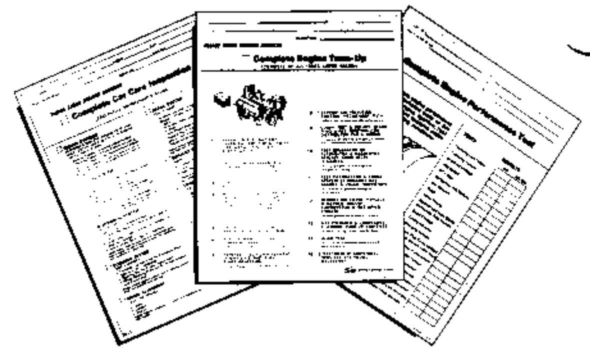
Sun's New Service Control System Display

a better way to communicate with your service customers.


Complete Car Care Inspection
Complete Engine Performance Test
Complete Engine Tune-Up
Complete Air Conditioning Service
Complete Winterizing Services
STARTING
IDLING
CRUISING
ACCELERATION
HIGH SPEED

DISPLAY CONTENTS:

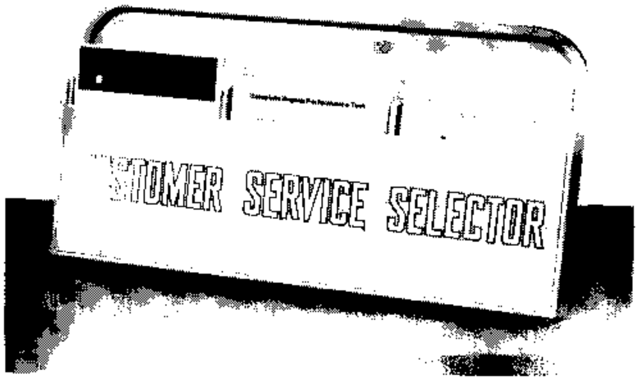
- One Set of Pricing Posters: (25" x 36")
  5 Complete Car Care Inspection
  5 Complete Engine Performance Test
  5 Complete Engine Tune-up
  5 Complete Air Conditioning Service
  5 Complete Winterizing Service


Complete Car Care Inspection
Complete Engine Tune-Up
Complete Engine Performance Test

- One Set of Service Selling Guides: (8½" x 11")
  125 Complete Car Care Inspection
  250 Complete Engine Tune-Up
  250 Complete Engine Performance Test

Note: Other Guides Available Upon Request.

- One Literature Holder for Counter or Wall Display



For more details, call your local Sun representative today.

Sun ELECTRIC CORPORATION
HARLEM AND AVONDALE · CHICAGO, ILLINOIS 60631

Printed in U.S.A

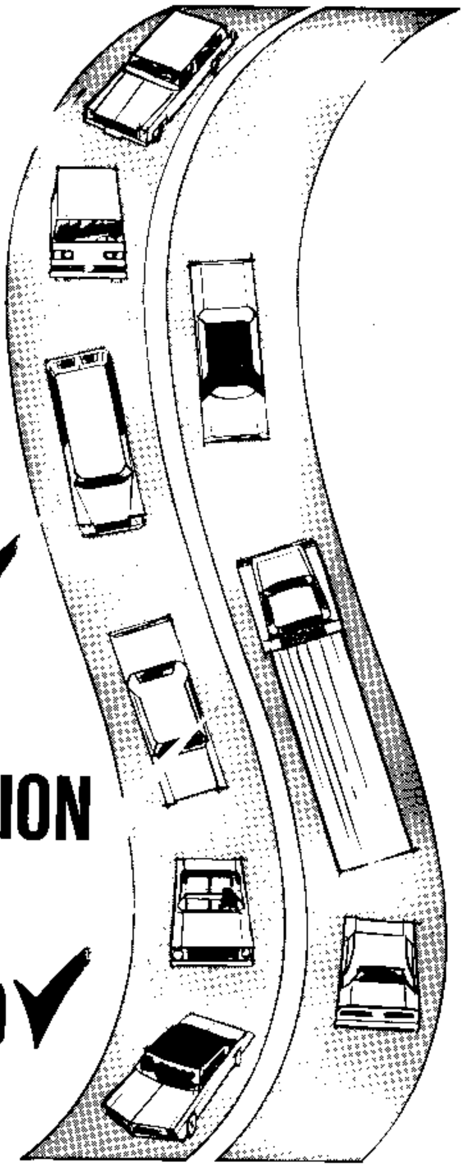
CUSTOMER________ NE________

MAKE-YEAR-MODEL________ MI________

SIGN________

Complete Engine Performance Test

This complete engine performance evaluation includes tests of the starting, charging, ignition, fuel and compression systems under all critical operating conditions:



STARTING

IDLING ✓

CRUISING ✓
CITY-COUNTRY

ACCELERATION

HIGH SPEED ✓
EXPRESSWAY

TESTS	**RESULTS** GO	NO GO
Cranking Coil Output		
Cranking Vacuum		
Cranking Voltage		
Idle Speed		
PCV Test		
Carburetor Idle Mixture		
Idle Vacuum		
Dwell		
Initial Timing		
Medium and High Speed Carburetor Fuel Mixture		
Dwell Change		
Timing Advance		
Charging Voltage		
Spark Plug Firing Voltage (at fast idle and under load)		
Accelerator Pump Action		
Maximum Coil Output		
Secondary Insulation		
Secondary Resistance		
Coil Condenser Condition		
Breaker Point Condition		
Distributor Cam Accuracy		
Cylinder Power Balance		

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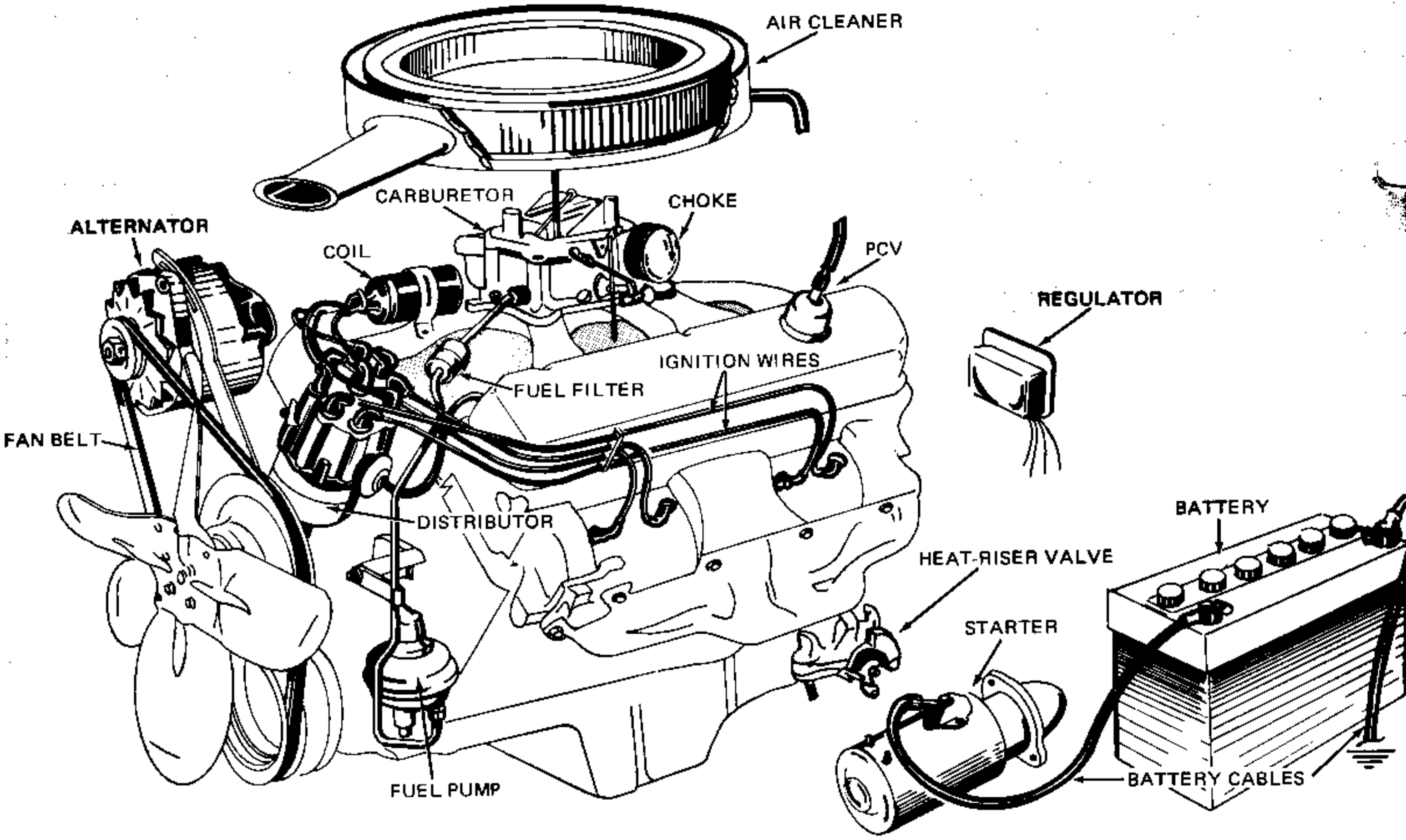


Service Recommendations

STARTING AND CHARGING SYSTEM

Good	Service	Replace	
☐	☐	☐	Battery
☐	☐	☐	Battery Cables
☐	☐	☐	Starter
☐	☐	☐	Alternator
☐	☐	☐	Regulator
☐	☐	☐	Fan and Drive Belts

Other ____________________

____

____

IGNITION SYSTEM

Good	Service	Replace	
☐	☐	☐	Spark Plugs
☐	☐	☐	Ignition Points
☐	☐	☐	Ignition Condenser
☐	☐	☐	Distributor Cap
☐	☐	☐	Distributor Rotor

Other ____________________

____

____

FUEL SYSTEM

Good	Service	Replace	
☐	☐	☐	Air Filter
☐	☐	☐	Choke
☐	☐	☐	Carburetor
☐	☐	☐	Fuel Filter
☐	☐	☐	PCV Valve
☐	☐	☐	Heat-Riser Valve

Other ____________________

____

____

COMPRESSION SYSTEM

Good	Marginal	Service
☐	☐	☐

CYL No.	1	2	3	4	5	6	7	8
Comp. Lbs.								
Cyl Leakage %								

Comments ____________________

____

____

Cost Est: Parts __________ Labor __________

CUSTOMER ____________________ [redacted] DATE [redacted]

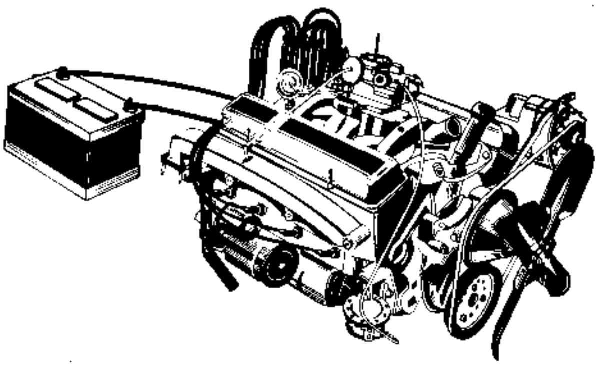
MAKE-YEAR-MODEL ____________________

SIGNATURE

PLEASE CHECK DESIRED SERVICES

Complete Engine Tune Up

(CONSISTS OF ALL ITEMS [redacted]



1 ☐ **SERVICE & TEST BATTERY—CLEAN BATTERY TOP & CABLES—RECHARGE IF NEEDED—TEST STARTER**
(Helps prevent unpredicted starting failures)

2 ☐ **TEST CYLINDER BALANCE & COMPRESSION FACTORS**
(Needed for smooth idle, economy & good performance)

3 ☐ **CLEAN OR REPLACE SPARK PLUGS AS NEEDED**

4 ☐ **REMOVE DISTRIBUTOR FROM ENGINE FOR SERVICE—TEST MECHANICAL & ELECTRICAL CONDITION—CALIBRATE ADVANCE MECHANISM**
(Has direct bearing on gasoline mileage & performance—also permits proper installation of ignition points)

5 ☐ **REPLACE IGNITION POINTS IF NEEDED & SET INITIAL TIMING**

6 ☐ **SERVICE MANIFOLD HEAT CONTROL VALVE**
(Affects warm-up & running performance)

7 ☐ **REPLACE FUEL FILTER ELEMENT IF NEEDED & TEST FUEL PUMP OPERATION**
(To guard against unpredictable road failures)

8 ☐ **SERVICE AIR POLLUTION CONTROL MECHANISM—P.C.V.**
(Affects fuel air ratio and idle performance)

9 ☐ **CLEAN, TEST & SERVICE SPARK PLUG WIRES, IGNITION COIL, DISTRIBUTOR CAP & ROTOR**
(Helps prevent starting & missing problems due to dampness and/or resistance)

10 ☐ **TEST GENERATOR OR ALTERNATOR & REGULATOR—REPLACE DRIVE BELTS IF NEEDED**
(To insure battery will be kept fully charged for starting)

11 ☐ **TEST CARBURETOR & CHOKE SYSTEM BY EXHAUST GAS SAMPLE & VISUAL INSPECTION**
(For maximum gasoline mileage & performance)

12 ☐ **SERVICE AIR FILTER—REPLACE IF NEEDED—ADJUST CARBURETOR & IDLE SPEED LINKAGE**
(Affects general performance of engine)

13 ☐ **USE CYLINDER & CRANKCASE CHEMICAL TUNE-UP ADDITIVES**
(Prevent sticking valves, rings & lifters)

14 ☐ **ROAD TEST**
(For over-all automobile performance & general condition)

15 ☐ **TELEPHONE IF ADDITIONAL SERVICES ARE FOUND NECESSARY**

Sun ***SERVICE CONTROL SYSTEM***

692-710

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CUSTOMER____________________ PHONE__________ DATE__________

MAKE-YEAR-MODEL________________________ MILEAGE__________

SIGNATURE____________________

PLEASE CHECK DESIRED SERVICES

Complete Car Care Inspection

(PREVENTIVE MAINTENANCE GUIDE)

☐ ENGINE SYSTEMS

PERFORM COMPLETE ENGINE PERFORMANCE TEST OF THE FIVE CRITICAL ENGINE OPERATING SYSTEMS:

- Starting System
- Charging System
- Ignition System
- Compression System
- Fuel System (including exhaust emission levels)

(Helps protect against hard starting, hesitation on acceleration, stalling, missing, sluggishness, harmful exhaust emissions.)

☐ COOLING SYSTEM

TEST & INSPECT:

- Radiator, Radiator Hoses and Heater Hoses for Leaks.
- Radiator Cap for Proper Sealing.
- Coolant for Condition and Level.
- Water Pump for Leaks or Excessive Wear.
- All Drive Belts for Proper Tension and Condition.
- Install Chemical Additives as Necessary.

(Helps protect against damage to engine from unexpected loss of coolant, overheating or freezing.)

☐ SUSPENSION SYSTEM

TEST & INSPECT:

- Ball Joints for Excessive Wear.
- Shock Absorbers for Leaking and Loss of Control.
- Upper and Lower Control Arm Shafts for Wear or Damage.
- Stabilizer Bar Bushings for Looseness.

(Helps protect against road failure of suspension parts. Also protects against unnecessary swerving, bottoming and instability in crosswinds.)

☐ STEERING SYSTEM

TEST & INSPECT:

- Tie Rods, Tie-Rod Ends for Excessive Wear.
- Idler Arm for Looseness.
- Steering Box for Proper Adjustment.
- Power Steering Pump for Drive Belt Tension and Fluid Level.

(Helps protect against sudden loss of steering control. Also helps prevent hard steering.)

☐ WHEEL ALIGNMENT

TEST FOR PROPER:

- Caster
- Camber.
- Toe-In .

(Helps prevent excessive tire wear and instability at high speeds.)

☐ BRAKE SYSTEM

TEST & INSPECT:

- Brake Drums and Linings for Excessive Wear.
- Master Cylinder and Wheel Cylinders for Leaks.
- All Brake Hoses and Lines for Deterioration or Wear.
- Front Wheel Bearings for Excessive Wear.

  Repack the Front Wheel Bearings and Replace Front Grease Seals.
  Adjust the Brakes.

(Helps protect against sudden brake failure, brake damage from worn linings, brake pull and swerving.)

☐ EXHAUST SYSTEM

INSPECT:

- Exhaust System for Leaks, Damage and Deterioration.
- Heat-Riser Valve for Proper Operation.

(Helps protect against dangerous fumes entering your car—Also helps ensure quick warm-ups.)

☐ TIRES

TEST & INSPECT FOR:

- Acceptable Tread Depth.
- Tread or Sidewall Damage.
- Uneven Tire Wear.
- Proper Inflation.
- Balance.

(Helps prevent unpredicted road failure, excessive tire wear and vibration.)

☐ LIGHTS

TEST & INSPECT:

- Headlights for Proper Operation and Aiming.
- Tail Lights, Brake Lights, Turn Signals, Parking Lights and Four-Way Flashers for Proper Operation.

(Makes sure all your lights are working properly for safe day and night driving.)

☐ AIR CONDITIONING SYSTEM

TEST & INSPECT:

- Air Temperature at Cooling Vents.
- System Operating Pressures.
- Complete System for Leaks.
- Hardware, Hoses and Seals for Wear, Deterioration or Damage.
- Drive Belts for Proper Tension.

(Helps protect against loss of cooling power, sudden system failure and damage to the system from lose of refrigerant.)

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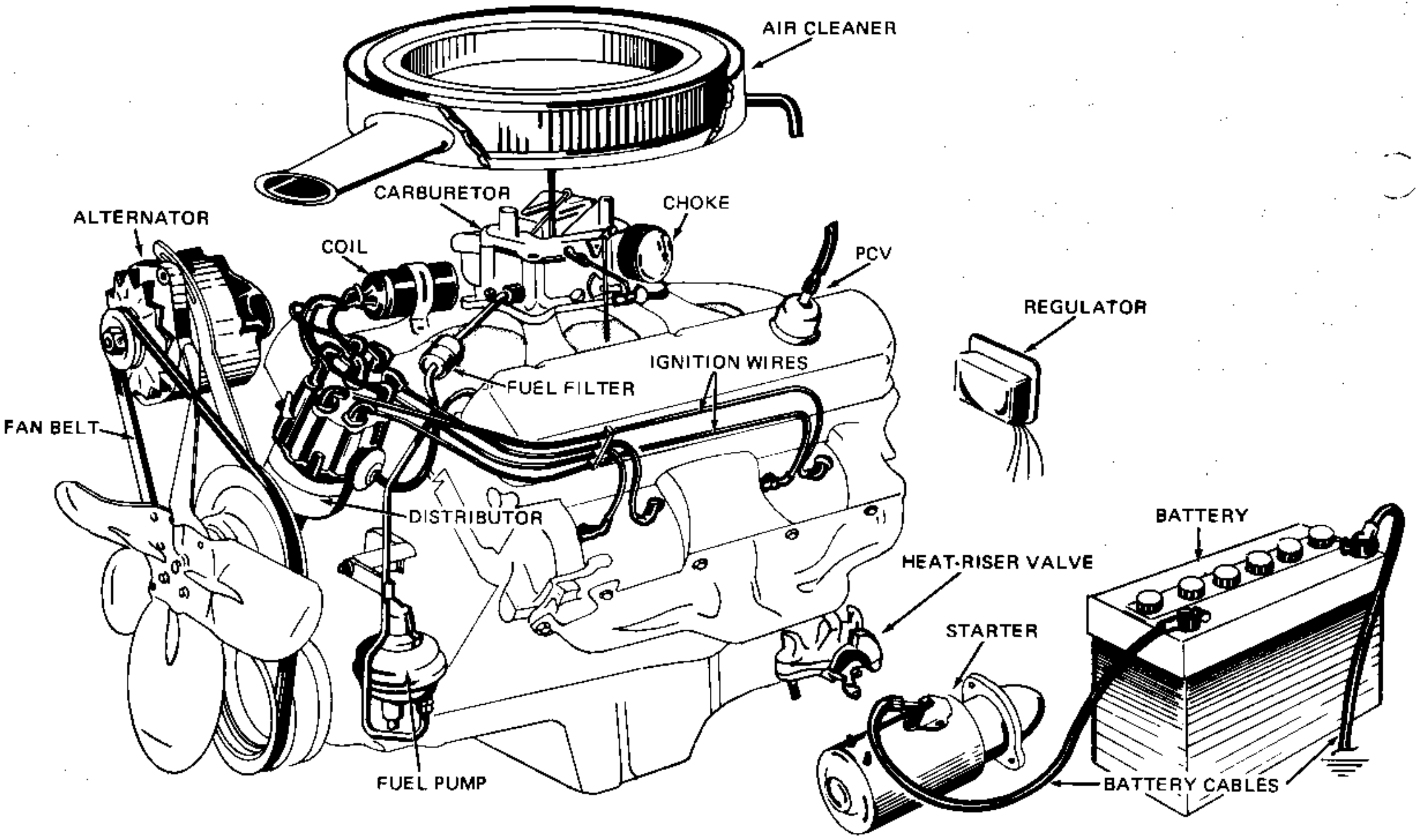


ENGINE SYSTEMS

STARTING AND CHARGING SYSTEM

Good	Service	Replace	
☐	☐	☐	Battery
☐	☐	☐	Battery Cables
☐	☐	☐	Starter
☐	☐	☐	Alternator
☐	☐	☐	Regulator
☐	☐	☐	Fan and Drive Belts

Other ______________________________

____

____

IGNITION SYSTEM

Good	Service	Replace	
☐	☐	☐	Spark Plugs
☐	☐	☐	Ignition Points
☐	☐	☐	Ignition Condenser
☐	☐	☐	Distributor Cap
☐	☐	☐	Distributor Rotor

Other ______________________________

____

____

FUEL SYSTEM

Good	Service	Replace	
☐	☐	☐	Air Filter
☐	☐	☐	Choke
☐	☐	☐	Carburetor
☐	☐	☐	Fuel Filter
☐	☐	☐	PCV Valve
☐	☐	☐	Heat-Riser Valve

Other ______________________________

____

____

COMPRESSION SYSTEM

Good	Marginal	Service
☐	☐	☐

CYL No.	1	2	3	4	5	6	7	8
Comp. (Lbs.)	___	___	___	___	___	___	___	___
Cyl Leakage (%)	___	___	___	___	___	___	___	___

Comments ______________________________

____

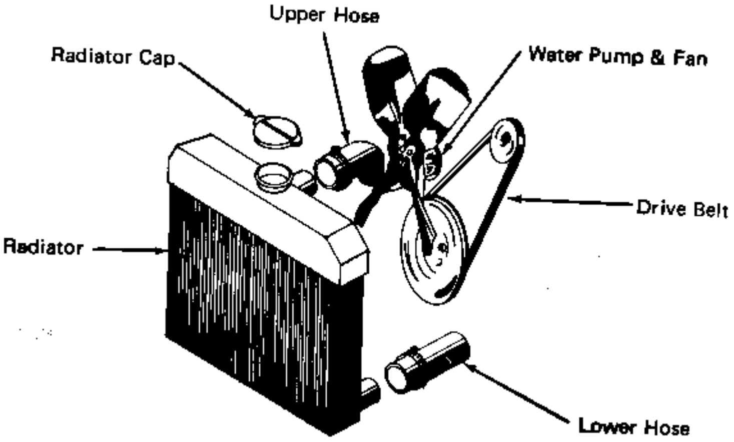
____

COOLING SYSTEM

Good	Service	Replace	
☐	☐	☐	Radiator
☐	☐	☐	Radiator Hoses
☐	☐	☐	Heater Hoses
☐	☐	☐	Radiator Cap
☐	☐	☐	Drive Belts
☐	☐	☐	Coolant
☐	☐	☐	Chemical Additives Installed
☐	☐	☐	Water Pump

Other: ______________________________

____

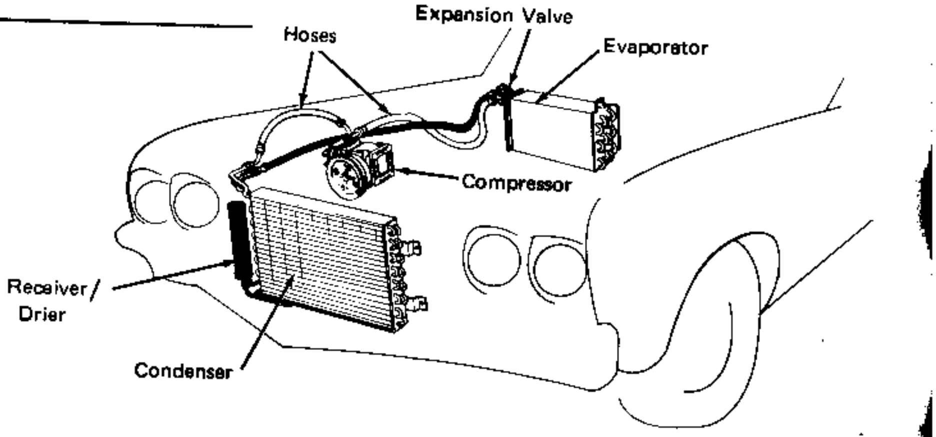


AIR CONDITIONING SYSTEM

Good	Service	Replace	
☐	☐	☐	Compressor
☐	☐	☐	Evaporator
☐	☐	☐	Condenser
☐	☐	☐	Hoses
☐	☐	☐	Receiver/Drier
☐	☐	☐	Control Valve
☐	☐	☐	Expansion Valve

Other: ______________________________

____

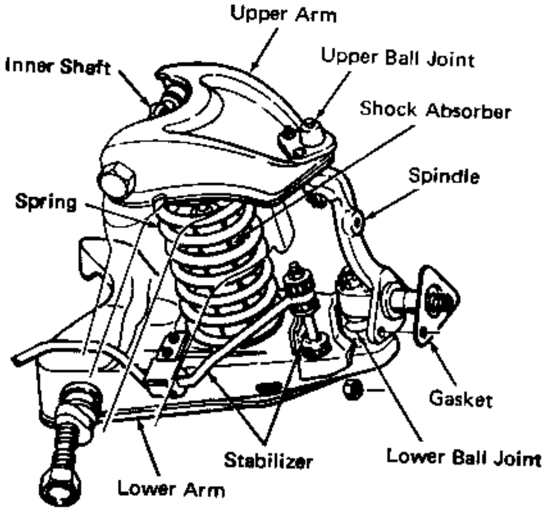


SUSPENSION SYSTEM

Good	Service	Replace	
☐	☐	☐	Upper Ball Joint
☐	☐	☐	Lower Ball Joint
☐	☐	☐	Front Shocks
☐	☐	☐	Rear Shocks

Other: ______________________________

____



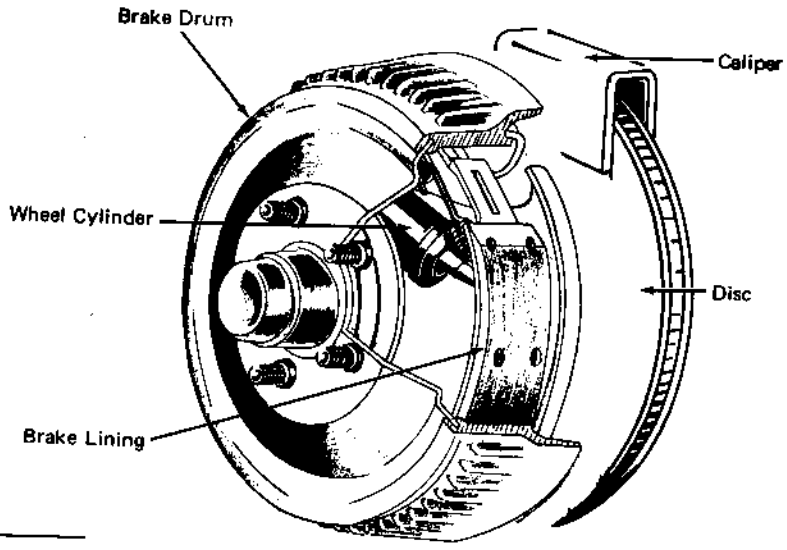
BRAKE SYSTEM

This service includes packing front wheel bearings, replacing front seals and adjusting the brakes.

Good	Service	Replace	
☐	☐	☐	Brake Drums (Discs) Front
☐	☐	☐	Brake Linings (Pads) Front
☐	☐	☐	Brake Drums (Discs) Rear
☐	☐	☐	Brake Linings (Pads) Rear
☐	☐	☐	Wheel Cylinders
☐	☐	☐	Brake Hoses
☐	☐	☐	Brake Lines
☐	☐	☐	Fluid Level
☐	☐	☐	Master Cylinder
☐	☐	☐	Front Wheel Bearings
☐	☐	☐	Rear Seals

Other: ______________________________

____

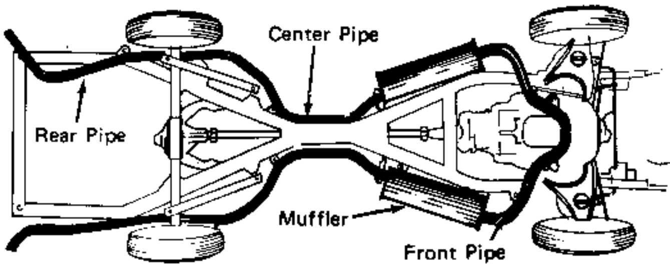


EXHAUST SYSTEM

Good	Service	Replace			
☐	☐	☐	Front Pipe	Left ☐	Right ☐
☐	☐	☐	Front Muffler	Left ☐	Right ☐
☐	☐	☐	Center Pipe	Left ☐	Right ☐
☐	☐	☐	Rear Muffler	Left ☐	Right ☐
☐	☐	☐	Rear Pipe	Left ☐	Right ☐
☐	☐	☐	Extension	Left ☐	Right ☐
☐	☐	☐	Heat-Riser Valve		

Other: ____

____

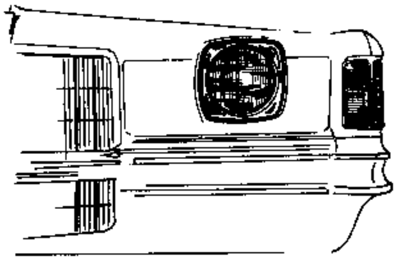


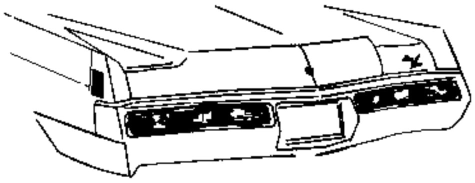
LIGHTS

Good	Service	Replace	
☐	☐	☐	Headlights
☐	☐	☐	Taillights
☐	☐	☐	Brake Lights
☐	☐	☐	Turn Signals
☐	☐	☐	Parking Lights
☐	☐	☐	Four-Way Flasher

Other: ____

____



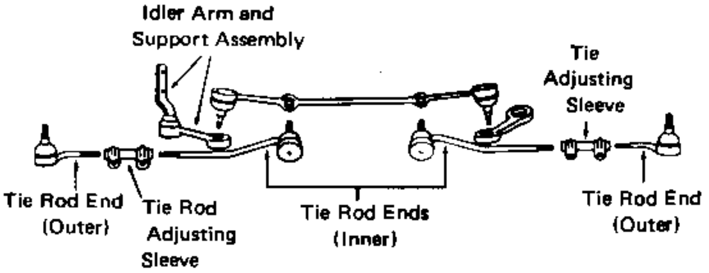


STEERING SYSTEM

Good	Service	Replace	
☐	☐	☐	Tie Rod End (Left Outer)
☐	☐	☐	Tie Rod End (Right Outer)
☐	☐	☐	Tie Rod End (Left Inner)
☐	☐	☐	Tie Rod End (Right Inner)
☐	☐	☐	Idler Arm

Other: ____

____

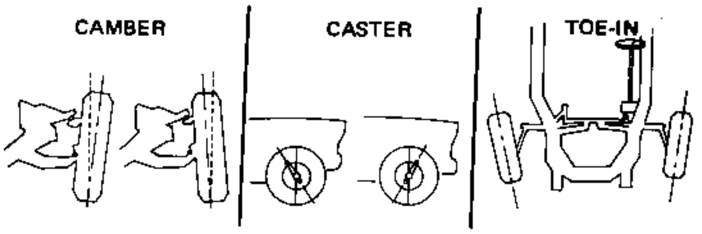


WHEEL ALIGNMENT

Good	Service		
☐	☐	☐	Camber
☐	☐	☐	Caster
☐	☐	☐	Toe-In

Other: ____

____

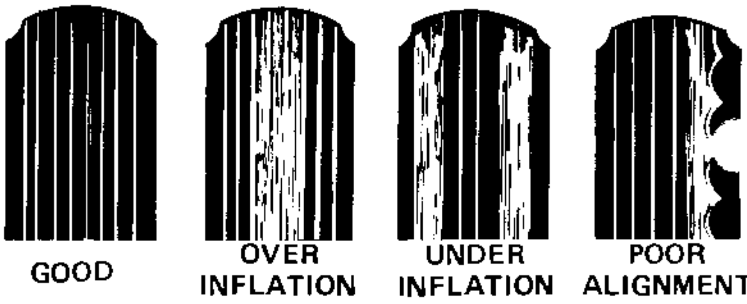


TIRES

Good	Service	Replace	
☐	☐	☐	Left Front
☐	☐	☐	Right Front
☐	☐	☐	Left Rear
☐	☐	☐	Right Rear
☐	☐	☐	Spare

Other: ____

____



Sun SERVICE CONTROL SYSTEM

CUSTOMER ____________________ DATE ____________________

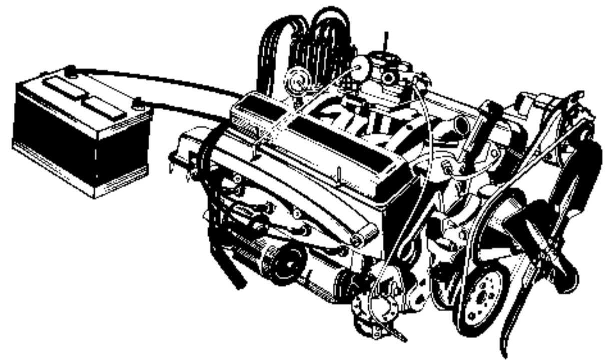
MAKE-YEAR-MODEL ____________________ MILEAGE ____________________

SIGNATURE ____________________

PLEASE CHECK DESIRED SERVICES

Complete Infra-Red Engine Tune-Up

(CONSISTS OF ALL ITEMS LISTED BELOW)



1 ☐ **USE INFRARED EXHAUST GAS ANALYSIS & VISUAL INSPECTION TO TEST & ADJUST CARBURETOR & CHOKE**

(N[illegible] smooth idle, economy, go[illegible]mance & low exhaust emissions)

2 ☐ **TEST CYLINDER BALANCE & COMPRESSION FACTORS**

(Needed for smooth idle, economy & good performance)

3 ☐ **CLEAN OR REPLACE SPARK PLUGS AS NEEDED**

4 ☐ **REMOVE DISTRIBUTOR FROM ENGINE FOR SERVICE—TEST MECHANICAL & ELECTRICAL CONDITION—CALIBRATE ADVANCE MECHANISM**

(Has direct bearing on gasoline mileage, exhaust emissions & performance—also permits proper installation of ignition points)

5 ☐ **REPLACE IGNITION POINTS IF NEEDED & SET INITIAL TIMING**

6 ☐ **SERVICE MANIFOLD HEAT CONTROL VALVE**

(A[illegible]rm-up & running performance)

7 ☐ **REPLACE FUEL FILTER ELEMENT IF NEEDED & TEST FUEL PUMP OPERATION**

(To guard against unpredictable road failures)

8 ☐ **SERVICE AIR POLLUTION CONTROL MECHANISM—P.C.V.**

(Affects fuel air ratio and idle performance)

9 ☐ **CLEAN, TEST & SERVICE SPARK PLUG WIRES, IGNITION COIL, DISTRIBUTOR CAP & ROTOR**

(Helps prevent starting & missing problems due to dampness and/or resistance)

10 ☐ **TEST GENERATOR OR ALTERNATOR & REGULATOR—REPLACE DRIVE BELTS IF NEEDED**

(To insure battery will be kept fully charged for starting)

11 ☐ **SERVICE & TEST BATTERY—CLEAN BATTERY TOP & CABLES—RECHARGE IF NEEDED—TEST STARTER**

(Helps prevent unpredicted starting failures)

12 ☐ **SERVICE AIR FILTER—REPLACE IF NEEDED**

(Affects general performance of engine)

13 ☐ **USE CYLINDER & CRANKCASE CHEMICAL TUNE-UP ADDITIVES**

(Helps prevent sticking valves, rings & lifters)

14 ☐ **ROAD TEST**

(For over-all automobile performance & general condition)

15 ☐ **TELEPHONE IF ADDITIONAL SERVICES ARE FOUND NECESSARY**

Sun SERVICE CONTROL SYSTEM

692-743

Printed in U.S.A

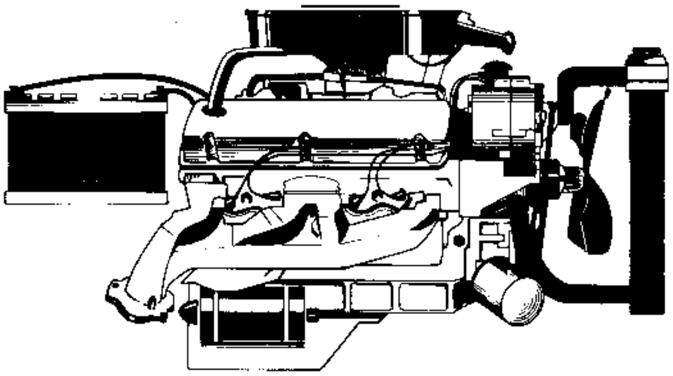
CUSTOMER ______ PHONE ______ DATE ______

MAKE-YEAR-MODEL ______ MILEAGE ______

LEASE CHECK DESIRED SERVICES

☐ Complete Winterizing Services

PREPARE YOUR CAR FOR WINTER *NOW!*



1 ☐ **INSPECT, ADD, OR CHANGE ANTI-FREEZE AS NEEDED**
(To protect your engine from winter damage)

2 ☐ **CLEAN COOLING SYSTEM IF NEEDED**
(Helps prevent overheating and road failure)

3 ☐ **TEST & INSPECT THERMOSTAT**
(Affects efficient operation of heater and engine)

4 ☐ **REPLACE WORN HOSES AND CLAMPS**
(To prevent loss of anti-freeze and engine failure)

5 ☐ **ADD COOLING SYSTEM RUST PROTECTOR AND WATER PUMP LUBRICANT**
(Helps to keep system clean and operating efficiently)

6 ☐ **INSPECT & REPLACE RADIATOR CAP IF NEEDED**
(Affects heater & engine operation)

7 ☐ **ADD COOLING SYSTEM SEALER**
(To prevent loss of anti-freeze through seepage)

8 ☐ **INSTALL WINDSHIELD WASHER ANTI-FREEZE**
(Helps clean windshield and keep washers working below 32 degrees)

9 ☐ **INSPECT AND REPLACE WINDSHIELD WIPER BLADES IF NEEDED**
(To properly clean windshield of slush and road salts for safety)

10 ☐ **COMPLETE ENGINE TUNE-UP INCLUDES 11 & 12**
(Helps prevent engine failure and insure good winter driving performance without costly service calls)

11 ☐ **SERVICE AND TEST BATTERY— CLEAN TOP AND CABLES— RECHARGE IF NEEDED— TEST STARTER**
(Helps prevent unpredicted starting failures)

12 ☐ **TEST GENERATOR OR ALTERNATOR & REGULATOR— REPLACE DRIVE BELTS IF NEEDED**
(To insure battery will be kept fully charged for starting)

13 ☐ **INSTALL SNOW TIRES**
(To insure winter driving safety)

14 ☐ **CHANGE OIL TO WINTER GRADE**
(Helps prevent engine wear and makes cold weather starting easier)

15 ☐ **CHANGE OIL FILTER**

16 ☐ **LUBRICATE CAR FOR WINTER**

17 ☐ **TELEPHONE IF ADDITIONAL SERVICES ARE FOUND NECESSARY**
(To help prevent the necessity of coming back a second time to complete all needed repairs)

***Sun* SERVICE CONTROL SYSTEM**

Printed in U.S.A.

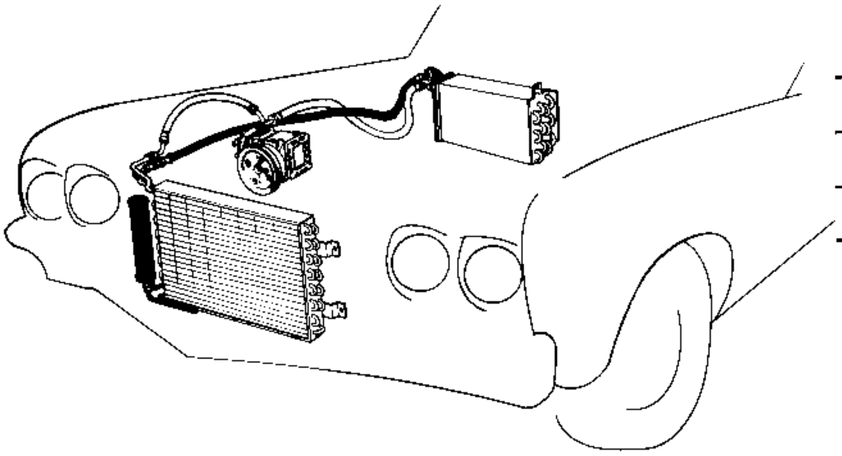
CUSTOMER [redacted]

MAKE-YEAR-MODEL ______ EAGE ______ A/C BRAND ______

TURE ______

EASE CHECK DESIRED SERVICES

Complete Air Conditioning Service



CUSTOMER'S COMMENTS: ______

1 TEST AIR TEMPERATURE AS IT LEAVES THE AIR CONDITIONER VENTS IN THE CAR.
(Tells if the air conditioner is cooling properly)

2 TEST AIR CONDITIONING SYSTEM FOR LEAKS.
(Prevents loss of cooling power and damage to the system)

3 REMOVE OLD REFRIGERANT, DRY OUT SYSTEM, RECHARGE WITH FRESH REFRIGERANT.
(Ensures proper cooling. Prevents damage from moisture in system)

4 INSPECT ALL AIR CONDITIONING HOSES, SEALS AND HARDWARE FOR WEAR, DETERIORATION OR DAMAGE.
(Prevents unexpected road failure and possible damage to the system)

5 INSPECT ALL DRIVE BELTS. ADJUST OR REPLACE AS NECESSARY.
(Helps prevent unpredicted road failure and engine overheating)

6 TEST ENGINE COOLING SYSTEM FOR LEAKS AND PROPER PRESSURIZATION.
(Helps prevent engine overheating)

7 INSTALL CHEMICAL ADDITIVES IN ENGINE COOLING SYSTEM.
(Helps prevent engine overheating)

Sun SERVICE CONTROL SYSTEM

Printed In USA

STARTING AND CHARGING SYSTEM DIAGNOSIS

CAR MAKE ____________ **YEAR** ______ **NO. OF CYLINDERS** ________ **VOLTAGE** ________

VISUAL INSPECTION

GOOD BAD

(At Time of Hook-Up)

1. Inspect connections and insulation of Battery Cables and wires. ☐ ☐
   Helps prevent starting failure.
2. Inspect Gen.-Alt. Belt tension and condition. ☐ ☐
   Helps prevent road failure.

1. BATTERY PERFORMANCE AND STARTING SYSTEM TESTS—

A. Load Battery until Red Ammeter scale reads three times A.H. rating for 15 seconds and observe green voltmeter scale. ☐ ☐

Minimum voltage should be ________ is ________.

ABOVE MINIMUM: Battery performance is good.

BELOW MINIMUM: Make complete battery test.

Prevents unpredicted starting failure.

B. Crank engine while observing green Voltmeter scale and Red ammeter scale. ☐ ☐

Minimum voltage should be ________ is ________.

Maximum amperes should be ________ is ________.

If battery passed step A; but cranking voltage is low—make sure battery has sufficient capacity (A.H.) for this application.

Good starters will read less than maximum cranking amperage specification with normal cranking speed—

A Must for easy starting.

2. ALTERNATOR-GENERATOR OUTPUT TEST—

At approx. 2000 RPM. Good AC type charging system must be within 5 amperes of specifications (D. C. type within specs.) ☐ ☐

Output should be ________ is ________.

The Charging system must supply sufficient current to operate the Ignition system and accessories while recharging the battery as you drive.

2A. OUTPUT TEST WITH FIELD CONTROL—

At approx. 2000 RPM. (Used only if step 2 is bad). If output is O. K. now—bad regulator is indicated. ☐ ☐

This condition will cause battery failure.

3. VOLTAGE REGULATOR TEST—

GOOD BAD

At approx. 2000 RPM. (consult specifications) ☐ ☐

Voltage should be ________ is ________.

Low voltage lets the battery run down causing failure. High voltage causes premature failure of the battery, headlights, ignition, points, etc.

4. DIODE-STATOR TEST

Reading in Red slashed Band indicates bad Gen.-Alt. although step #2 may have passed. ☐ ☐

Insures Alt.-Gen. does not have hidden defects that will cause failure or damage to voltage regulator.

PLUS! BATTERY DRAIN TEST-AMMETER MUST READ ZERO

(Doors must be closed with ignition switch and accessories off). ☐ ☐

Ammeter reading ____________.

Safeguard against battery failure from discharging while vehicle is not in use.

FINAL ANALYSIS

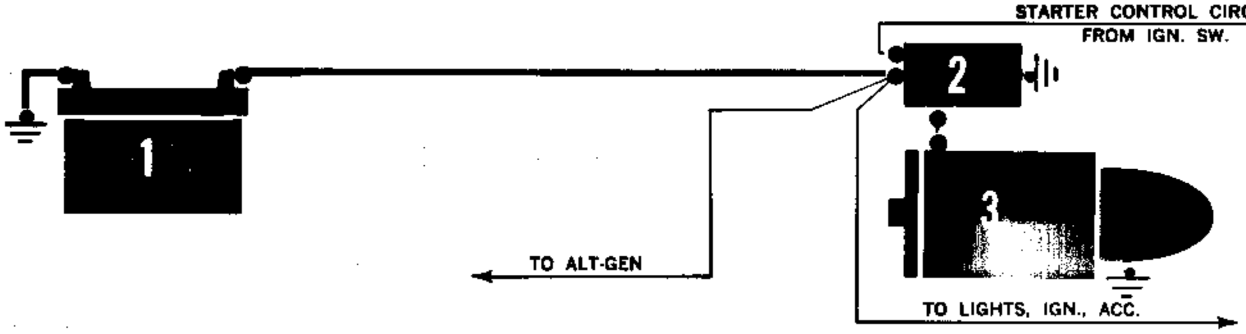
Visual Inspection
NEEDS: ____________
____

Starting System
NEEDS: ____________
____

Charging System
NEEDS: ____________
____

Battery and/or Drains
NEEDS: ____________
____

TYPICAL STARTING SYSTEM

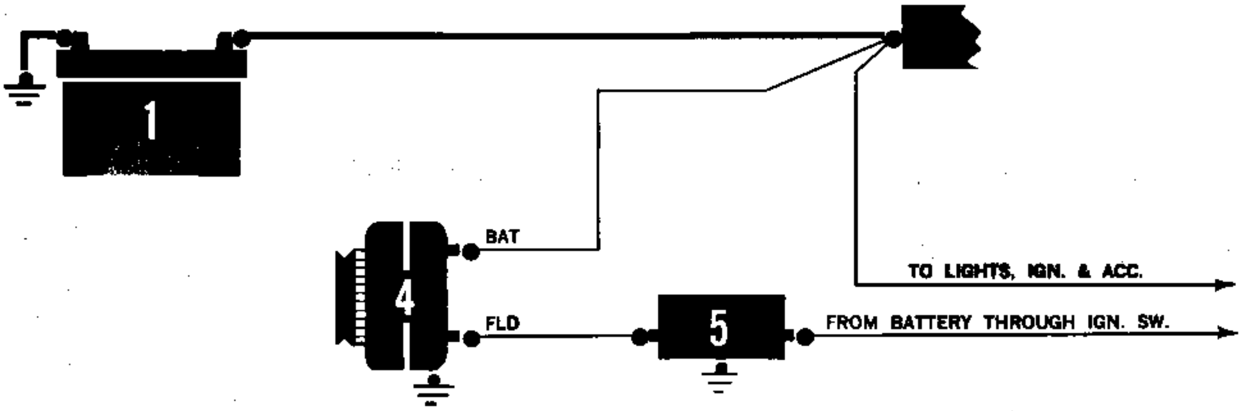


1. BATTERY
2. STARTER SWITCH
3. STARTING MOTOR

— CABLES

(CONNECTIONS INDICATED BY ●)

TYPICAL A. C. CHARGING SYSTEM

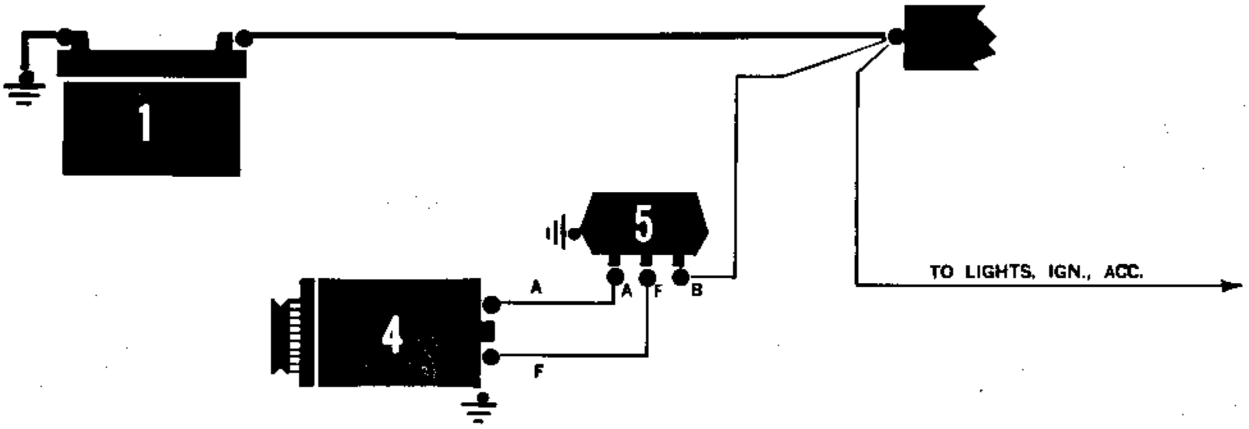


1. BATTERY
4. ALTERNATOR
5. VOLTAGE REGULATOR

— CABLES & WIRING

(CONNECTIONS INDICATED BY ●)

TYPICAL D. C. CHARGING SYSTEM



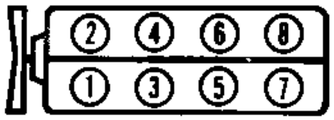
1. BATTERY
4. GENERATOR
5. REGULATOR UNIT

— CABLES & WIRING

(CONNECTIONS INDICATED BY ●)

1967 CAMARO V8 — TURBO FIRE 327 — 210 HP
327 CU. IN. ENGINE WITH 2 BBL. CARB.

WITHOUT AND WITH A.I.R. SYSTEM



TURBO-FIRE 327
327 CU. IN. ENGINE

ENGINE VAC. @ IDLE 16"-20"
COMP. RATIO 8.75-1
COMP. PRES. 160 PSI (MIN.)
MAX. VAR. 20 PSI
FIRING ORDER 1-8-4-3-6-5-7-2
HYD. LIFTERS — ZERO LASH + 1 TURN DOWN

IGNITION COIL
DELCO — 1115115

PRI. RES. 1.24-1.46 OHMS
SEC. RES. 6500-9500 OHMS
TEST SET LINE 8
IGNITION CURRENT
ENGINE STOPPED 4.0A — IDLING 1.8A

BALLAST RESISTOR
LOOM 1.8 OHMS @ 80°F.

CONDENSER CAPACITY
.18-.23 MFD

SPARK PLUGS
STAND. — AC 44
COLDER — AC 43
GAP — .035"
TORQUE — 20-25 FT./LBS.

IDLE SPEED

WITHOUT A.I.R. SYSTEM		WITH A.I.R. SYSTEM
500	Manual Trans.	700
600 (DR)	Auto Trans.	600 (DR)
(ON)	W/Air Cond.	(OFF)

HOT IDLE COMPENSATOR VALVE HELD CLOSED

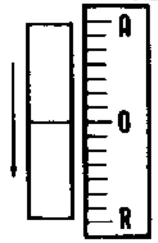
IGNITION TIMING

	W/O A.I.R.	W/A.I.R.
MANUAL TRANS.	2° BTDC	2° BTDC @ IDLE RPM
AUTO. TRANS.	2° BTDC	2° BTDC @ IDLE RPM

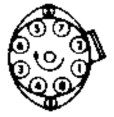
DIST. VAC. LINE DISCONNECTED AND PLUGGED

IGNITION ADVANCE
AT 2500 ENGINE RPM

	TOTAL CENT. VAC.	CENT. ONLY
WITHOUT A.I.R. SYSTEM —	29°-37°	16°-20°
WITH A.I.R. SYSTEM —	29°-37°	16°-20°



SET TO SPECIFIED DEGREES
EACH INCREMENT 2 DEGREES



FRONT OF ENGINE

Without A.I.R. System	DISTRIBUTOR	With A.I.R. System
1111101	Delco	1111101
C	Rotation	C
19-23 Oz.	Spring Tension	19-23 Oz.
30° (28°-32°)	Dwell	30° (28°-32°)
.019" NEW .016" USED	Gap	.019" NEW .016" USED
2° (MAX.)	Dwell Variation	2° (MAX.)

BETWEEN ENGINE IDLE AND 1500 RPM

DISTRIBUTOR

MECHANICAL ADVANCE

1111101		1111101	
DIST. RPM	DIST. DEG.	DIST. RPM	DIST. DEG.
450	0°	450	0°
1975	16°	1975	16°

VACUUM ADVANCE

1111101		1111101	
VAC.	DIST. DEG.	VAC.	DIST. DEG.
8"	0°	8"	0°
15½"	7½°	15½"	7½°

SECONDARY RESISTANCE — 3.0 MIN.

STARTER FREE SPEED CURRENT DRAW
1107320 — MODEL — 1107388
65-100 AMPS (INCLUDES SOLENOID) @ 10.6 VOLTS
3600-5100 RPM

BATTERY
12V NEG. GRD.
R59 — 6d AH

OPTIONAL — R69 — 70AH

CRANKING VOLTAGE
MIN. 9.0V

OPERATING VOLTAGE SETTING
AT 2000 RPM 13.8-14.8 VOLTS @ 85°F.

SOLENOID CURRENT DRAW
HOLD IN WINDINGS
14½-16½ AMPS @ 10 VOLTS
BOTH WINDINGS
41-47 AMPS @ 10 VOLTS

SOLENOID PULL IN VOLTAGE
7.7 VOLTS (MIN.)
SWITCH TERMINAL OF SOLENOID AND GROUND

STARTER MOTOR CIRCUIT RESISTANCE
INSULATED CIRCUIT — .4 VOLTS
BATTERY POS. POST TO STARTER MOTOR TERMINAL OF SOLENOID
BATTERY POSITIVE POST TO SOLENOID BATTERY TERMINAL — .2 VOLT
BATTERY TERMINAL OF SOLENOID TO MOTOR TERMINAL OF SOLENOID — .2 VOLT
GROUND CIRCUIT — .2 VOLT
BATTERY NEG. POST TO STARTER MOTOR HOUSING
SOLENOID CONTROL CIRCUIT — 3.5 VOLTS (MAX.)
BATTERY TERMINAL OF SOLENOID TO SWITCH TERMINAL OF SOLENOID

FUEL PUMP
PRES.
5¼-6½ PSI @ 450-1000 RPM

VOL.
1 PT. 30-45 SEC. @ IDLE RPM

FUEL FILTERS
FUEL TANK — STRAINER

CARB. — INLET FILTER

SERVICE AS REQUIRED

REPLACE ELEMENT
AS REQUIRED

Name ____

SPECIFICATION CARD WORKSHEET

Use 1967 Specification Card

1. Year ____
2. Car Make ____
3. Number of Cylinders ____
4. Displacement ____
5. Carburetor ____
6. Transmission type Manual
7. Horsepower ____
8. w/wo Anti Pollution Equip. without
9. w/wo Air Conditioning without
10. Spec. Card Number ____

11. CRANKING VOLTAGE (BATTERY section)
Spec ____ Volts

12. OPERATING VOLTAGE (BATTERY section)
Spec ____ RPM
____ to ____ Volts
@ ____ °F

13. IDLE SPEED
(IDLE SPEED section)
Spec ____ RPM

14. DWELL
(DISTRIBUTOR section)
Spec ____ °

15. INITIAL TIMING (DEGREES)
(IGNITION TIMING section)
Spec ____ ° TDC

16. IGNITION ADVANCE (DEGREES @ 2500 RPM)
(IGNITION ADVANCE section)
TOTAL CENT. VAC. ____

17. IGNITION ADVANCE (DEGREES @ 2500 RPM)
(IGNITION ADVANCE section)
CENT. ONLY ____

18. ENGINE VACUUM @ IDLE
(ENGINE DIAGRAM section)
Spec ____ inches

19. COMPRESSION PRESSURE
(ENGINE DIAGRAM section)
Spec ____ PSI

20. COMPRESSION PRESSURE AND MAXIMUM VARIATION
(ENGINE DIAGRAM section)
Spec ____ PSI
Max. var. ____ PSI

21. FIRING ORDER

(ENGINE DIAGRAM section) Spec ____________________

22. PRIMARY RESISTANCE

(IGNITION COIL section) Spec ____________________ ohms

23. SECONDARY RESISTANCE

(IGNITION COIL section) Spec ____________________ ohms

24. BALLAST RESISTOR RESISTANCE

(IGNITION COIL section) Spec ____________________ ohms

25. CONDENSER CAPACITY

(IGNITION COIL section) Spec ____________________ MFD.

26. DISTRIBUTOR ROTATION

(DISTRIBUTOR section) Spec ____________________

27. SPRING TENSION

(DISTRIBUTOR section) Spec ____________________ Oz.

28. FUEL PUMP PRESSURE

(FUEL PUMP section) Spec ____________________ PSI
@ ____________________ RPM

29. FUEL PUMP VOLUME

(FUEL PUMP section) Spec ____________________
@ ____________________ RPM

30. IGNITION CURRENT ENGINE STOPPED

(IGNITION COIL section) Spec ____________________ amps

31. IGNITION CURRENT ENGINE IDLING

(IGNITION COIL section) Spec ____________________ amps

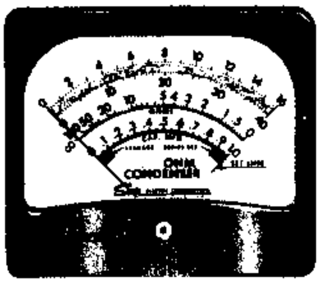
ZEROING SUN METERS and GAUGES

Follow these instructions before using a tester to assure the basic accuracy of its readings. Meters should be checked for correct zero position and adjusted as follows:

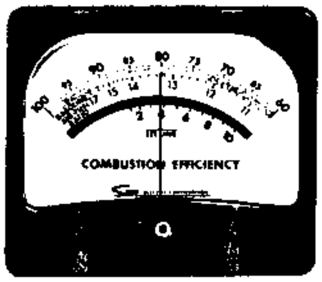
1. Turn the AC power switch OFF and disconnect any connections made to the vehicle.

2. Wait 30 seconds to permit circuits of the tachometer, dwellmeter, etc. to discharge.

3. a. Meters which zero at left end of scale: turn the zero corrector button on the front of the meter to the left or right until the needle is on the "0" line.



   b. Meters with center scale Set lines:
   turn the zero corrector button on the front of the meter to the left or right until the needle is on the SET LINE.



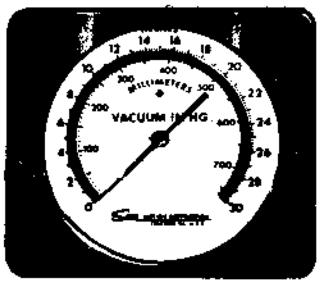
   c. Gauges of the Vacuum Gauge type:

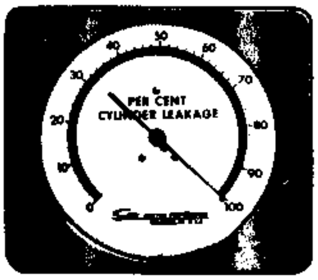
      1. Remove the rubber plug from the glass meter face.

      2. Use a small screwdriver and turn the adjusting screw on the meter face, left or right until the needle rests on 0.

   d. Gauges of the Cylinder Leakage type:

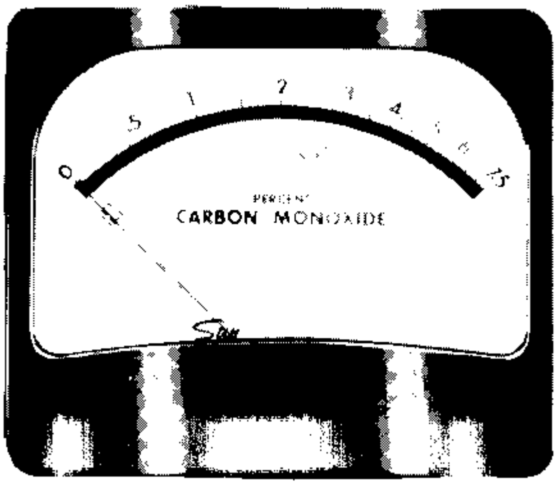
      No zeroing required.





INFRA-RED CO METER

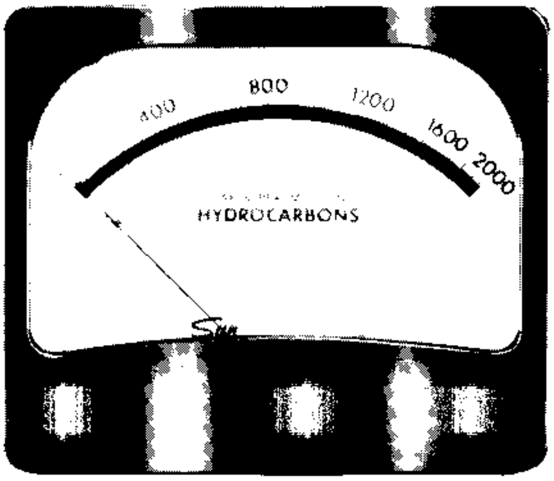
1. Turn the zero corrector button on the front of the meter, left or right, until the needle is on the 0 line at the left end of the scale.



To zero these meters turn the OFF /STANDBY/TEST switch to OFF.

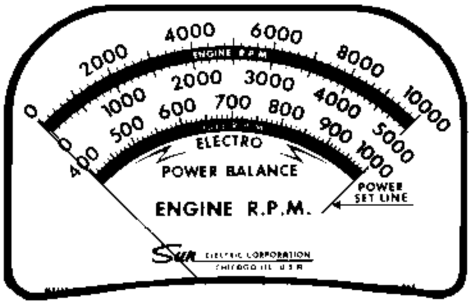
INFRA-RED HC METER

1. Turn the zero corrector button on the front of the meter, left or right, until the needle is on the 0 line at the left end of the scale.

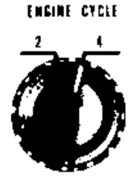


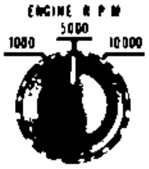
TACHOMETER
USED ON MODELS EET-920, 1120

The Tachometer measures the engine's operating speed in revolutions per minute, (RPM). The tachometer is used to set idle speed and idle mixture to test the PCV System. It is also used while following manufacturer's setting and testing procedures for exhaust emission control equipment.



The Tachometer uses the trigger pickup lead, an ENGINE CYCLE switch and an ENGINE RPM Selector Switch. The Tachometer may be triggered off any cylinder but since the pickup lead also triggers the Timing Light it is usually connected to the Timing Cylinder (NO. 1 cylinder).





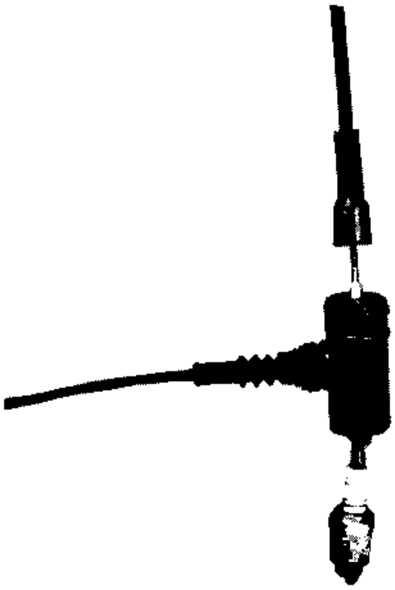
Idle Speed

To measure the idle RPM

1. Connect the trigger pickup lead to the NO. 1 cylinder, (or timing cylinder if different than NO. 1).
2. Set the ENGINE CYCLE switch to the proper position. Use 2 CYCLE position for Wankel (rotary) type engines.
3. Set the ENGINE RPM switch to 1000.
4. Start engine and measure idle speed after the engine is warmed up.

   GOOD Idle speed at specified RPM.

   BAD If the idle speed is more than 10 RPM from specified it should be readjusted.



IDLE MIXTURE

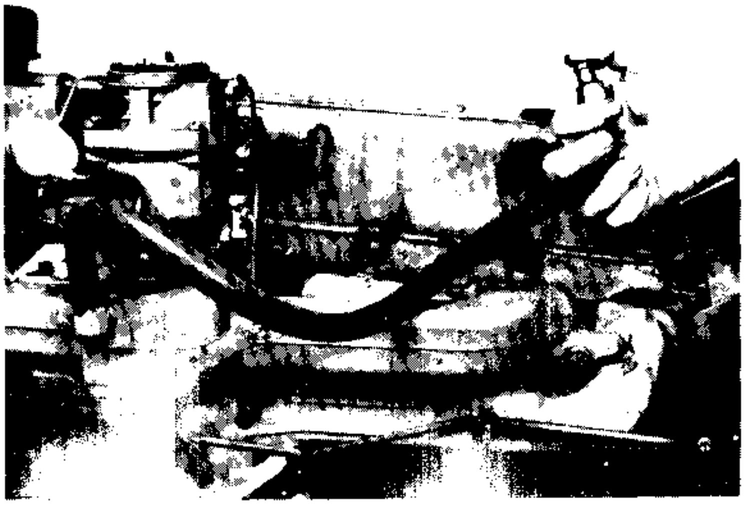
Follow these steps to adjust the idle mixture screws for proper idle mixture on pre-emission control engines only. For emission controlled engines, follow the manufacturer's procedures for setting and testing.

1. Set idle speed to specified RPM by adjusting idle speed screw.
2. Peak RPM with the idle mixture screw or screws. Hold the specified idle speed by adjusting idle speed screw.

   Results: Evaluate with the Combustion Efficiency meter.

PCV TEST

Make this test to determine if the PCV system is functioning properly:

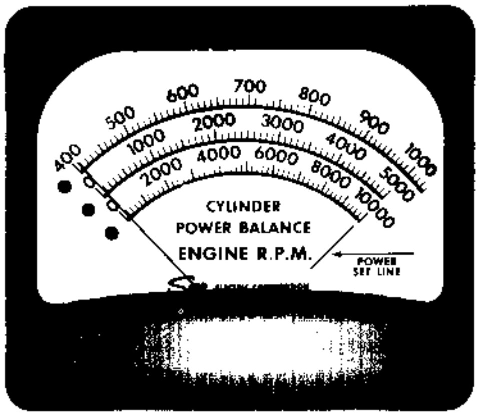


1. Operate engine at idle.
2. Note idle RPM.
3. Pinch off PCV hose or close off the end of the PCV valve.
4. Record change in RPM.

   GOOD Engine RPM drops a minimum of 50 RPM.

   BAD The engine speed does not change or changes less than 50 RPM indicates the PCV system requires service. Clean or replace PCV valve and hoses.

TACHOMETER
USED ON MODELS EET-1160, 945, 947

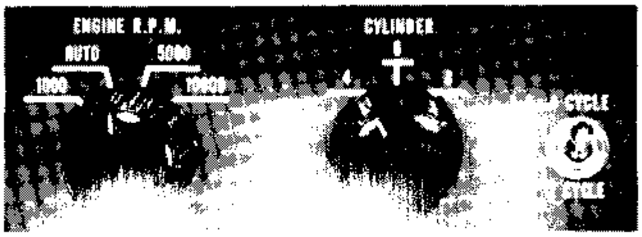


The Tachometer measures the engine's operating speed in revolutions per minute (RPM). Use the Tachometer to set idle speed and idle mixture, to test the PCV System. It is also used while following manufacturer's setting and testing procedures for exhaust emission control equipment.

The Tachometer uses three RPM scales: 1000, 5000, and 10,000. When testing an engine, read the scale whose Indicator Light is on.

You set two controls before testing an engine:

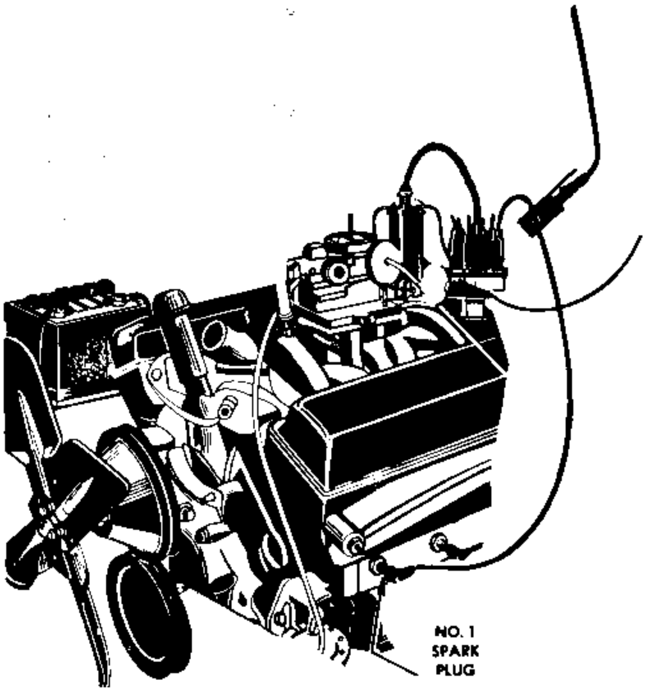
1. Set the engine CYCLE selector to 2 CYCLE or 4 CYCLE. Note: for Wankel (rotary) type engines use the 2 CYCLE position.
2. Set the ENGINE RPM selector to 1000, AUTO, 5000 or 10,000 depending on the speed range of the test.



In the AUTO position the Tachometer will read engine speeds from 400 RPM to 5000 RPM by automatically switching back and forth between the 1000 and 5000 scales. You don't have to touch the ENGINE RPM Selector. An Indicator Light will tell you which scale to read. The Tachometer can be manually changed to the 1000, 5000, or 10,000 RPM scales.

HOOK UP

To hook up the Tachometer simply place the clamp-on Trigger pick-up over the NO. 1 spark plug wire near the distributor.



AREA TESTS

Idle Speed

To measure the idle RPM.

1. Clamp the Trigger pickup onto the NO. 1 plug wire.
2. Set the engine CYCLE Selector to the position that matches the type of engine to be tested.
3. Set the ENGINE RPM Selector to AUTO.
4. Start engine and measure idle speed after the engine is warmed up.

   GOOD Idle speed at specified RPM.

   BAD If the idle speed is more than 10 RPM from specified, it should be readjusted.

Idle Mixture

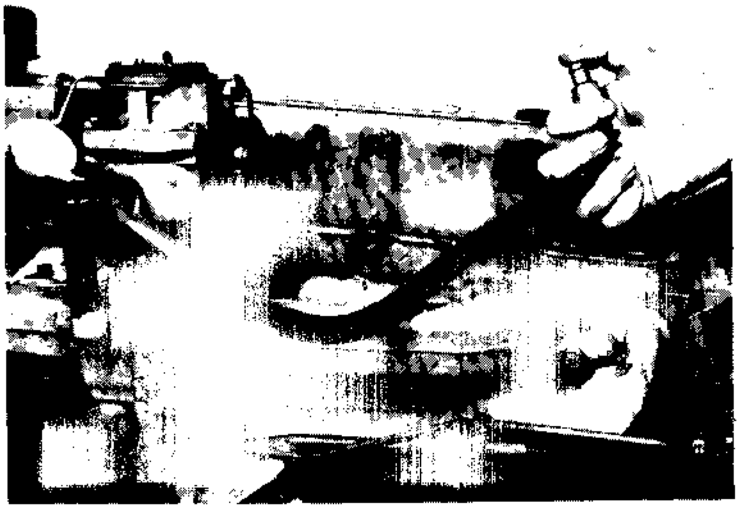
Follow these steps to adjust the idle mixture on pre-emission control engines only. For emission controlled engines, follow the manufacturers' procedures for adjusting and testing.

1. Set idle speed to specified RPM by adjusting idle speed screw.
2. Adjust the carburetor idle mixture screw(s) for maximum RPM.
3. Readjust engine idle speed to specified RPM.

PCV TEST

Make this test to determine if the PCV system is functioning properly.

1. Operate engine at idle.
2. Note idle RPM.
3. Pinch off PCV hose or close off the end of the PCV valve.



4. **Record the engine RPM.**

   GOOD Engine RPM drops a minimum of 50 RPM.

   BAD The engine speed does not change or changes less than 50 RPM indicates the PCV system requires service. Clean or replace the PCV valve and hoses.

Follow these steps to measure or set the dwell of the ignition points:

1. Connect the trigger pickup lead to NO.1 cylinder spark plug.

2. Connect the red clip-on lead of the Pattern Pickup lead to the distributor terminal of the coil.

3. Connect the black clip-on lead of the Pattern Pickup to a good engine ground.

4. Start the engine; set idle to specified RPM.

5. Read dwell meter.

   GOOD Dwell within specifications.

   BAD Dwell not within specifications. Check condition of contact points and then reset.

DWELL VARIATION

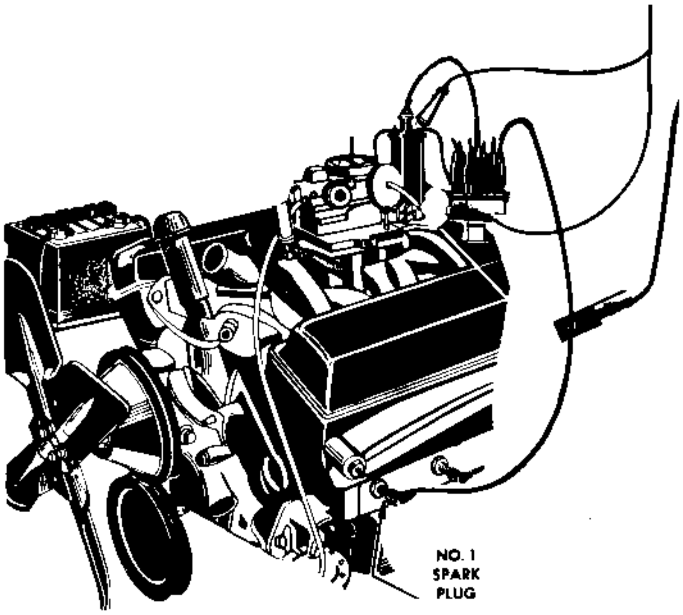
Make this test to determine if worn components in the distributor are causing a change in dwell as engine speed increases:

1. Move the Engine RPM knob to Auto.

2. Increase the engine speed to 1500 RPM or to speed specified by Mfg.

   GOOD Maximum change within specifications or if not specified, not more than 3 degrees.

   BAD Excessive change in dwell indicates worn components in distributor. Remove distributor for further testing and service.



DISTRIBUTOR RESISTANCE TEST

Make this test to determine if there is excessive electrical resistance in the distributor primary circuit. This test checks the ignition points, wire connections, distributor pigtail lead and the distributor ground.

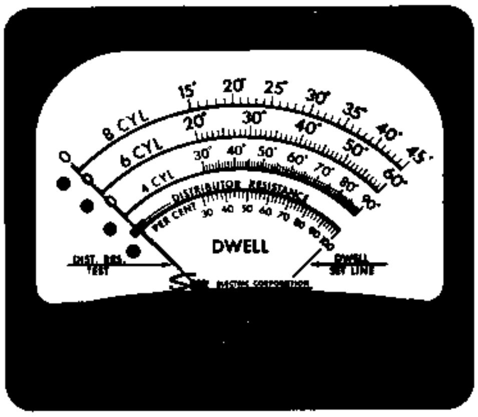
1. Place the DWELL/DIST. RES Switch in the DIST. RESISTANCE position.

2. Crank the engine to make sure the ignition points are closed. When the points close, the dwell meter's needle will move toward the left end of the scale.

3. Turn the ignition switch on and note the position of the DWELL METER needle.

   GOOD Needle rests in the BLACK BAND at the left end of the Per Cent Dwell Scale.

   BAD If the needle reads out of the black band, there is excessive resistance in the distributor's primary circuit. Check the contact points for dirty, burnt or pitted contacts. Also check for poor lead connections, broken pigtail leads or a bad distributor to engine block ground.



Name ______________

TACHOMETER AND DWELLMETER WORKSHEET

Eng. No. ____________ | Make/Year ____________________

		GOOD	BAD
IDLE RPM (within 10 RPM of specification)			
Spec ______________ RPM	Measured ______________ RPM	☐	☐
PCV TEST (50 RPM drop with PCV closed off)			
Idle RPM ___________ RPM	Measured ______________ RPM	☐	☐
DWELL (within specification)			
Spec _______________ °	Measured ______________ °	☐	☐
DWELL VARIATION (within specification or if not specified more than 3°)			
Spec _______________ °	Measured ______________ °	☐	☐
DISTRIBUTOR RESISTANCE (black band)			
	Measured IN ______ OUT	☐	☐

Name______________________________

Specification Card Quiz

Use 1969 Specification Card

1. Year____________________
2. Car Make_________________
3. Number of Cylinders______
4. Displacement_____________
5. Carburetor_______________

6. Transmission Type *Auto Trans.*
7. Horsepower______________________
8. Spec. Card Number________________

w/wo Anti Pollution Equip. *with*

w/wo Air Conditioning *with*

9. Cranking voltage (min.)

(BATTERY section of spec card) Spec__________Volts

10. Operating voltage

(In section labeled CHARGING SYSTEM) Spec____to____Volts

11. Idle RPM

(IDLE section) Spec_________RPM

12. Dwell (Degrees)

(DWELL section) Spec__________°

13. Initial timing (Degrees)

(IGNITION TIMING section) Spec_____@_____RPM

14. Ignition Advance (Degrees @ 2500 RPM)

(IGNITION ADVANCE) Cent. & Vac.________

15. Ignition Advance (Degrees @ 2500 RPM)

(IGNITION ADVANCE) Cent. only___________

16. Firing Order

(ENGINE) Spec_____________

17. Compression Pressure

(ENGINE) Spec_____________

18. Fuel Pump Pressure

(FUEL PUMP) Spec________PSI@____________

19. Fuel Pump Volume

(FUEL PUMP) Spec________@________________

20. Fuel Pump Vacuum

(FUEL PUMP) Spec________inches @___________

21. Distributor Rotation

(DISTRIBUTOR) Spec____________

22. Spring Tension

(DISTRIBUTOR) Spec____________oz.

23. Condenser Capacity

(DISTRIBUTOR) Spec____________Mfd.

24. Primary Resistance

(IGNITION COIL) Spec_________ohms @_______°

25. Secondary Resistance

(IGNITION COIL) Spec_________ohms @_______°

26. Ignition Current

Engine Stopped Spec___________amps

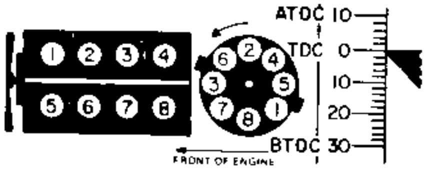
27. Ignition Current

Engine Idling Spec___________amps

1969 FORD FALCON MONTEGO FAIRLANE MUSTANG METEOR

V8 302 CU. IN. ENGINE 10 HP V/2 BBL. CARB.—IMCO EMISSION CONTROL

ENGINE 302 Cu. In.



Firing Order	1-5-4-2-6-3-7-8
Hyd. Lifters	Zero Lash + 1 turn down
Clearance at valve stem tip (.067"-.167")	hyd. tappet collapsed .117"
Plate Symbol	F
Comp. Ratio	9.5-1
Comp. PSI	Max variation of comp. readings Highest cyl. to lowest cyl. not to exceed 25%

BATTERY 12v Neg. Grd.

Standard	SV21R	45AH
W/Air Cond.	AL24F-SV24F	55AH
Optional	SV27F	70AH
Cranking Voltage (min)	9.6v	
Cranking Speed	150-250 RPM	
Starter Draw (cranking)	150-200A	

CHARGING SYSTEM

	Standard	W/Air Cond.
Output (min)	37A	50A
Operating Voltage 50-125°F (measured at battery)	13.5-15.3v	13.5-15.3v

IDLE

Engine Vac. 15" min.

RPM (set with headlights on hi beam)
(apply park brake firmly)
(automatic load leveler compressor inactive.)
WITH AIR CLEANER REMOVED—Plug vac. override hose.
WITH THERMAL SENSING VALVE—Disconnect manifold vac. red stripe hose at the sensing valve and plug manifold vac. hose.

Manual Trans.	650 W/Air Cond. on
Auto. Trans. (DR)	550 W/Air Cond. off

DWELL (Degrees)

At Idle (dist. vac. lines disconnected and plugged)

Manual Trans.	24-29
Auto. Trans.	26-31
Variation	6 (dist. vac. lines connected)

IGNITION TIMING (Degrees)

Dist. Vac. Lines Disconnected and Plugged

Manual Trans.	6 BTDC @ Idle RPM

Reconnect Dist. Vac. Lines-Should Retard to 4-6ATDC

Auto. Trans.	6 BTDC @ Idle RPM

IGNITION ADVANCE (Degrees @ 2500 RPM)

	Cent. & Vac.	Cent. Only
Manual Trans.	31-41	14-19
Auto. Trans.	31½-41	13½-18

IDLE MIXTURE

Air cleaner installed-Vac override hose connected
Air Fuel Ratio-Refer to Procedure Card

Manual Trans.	14.0
Auto. Trans.	13.8

FUEL PUMP

Press.	4½-6½ PSI @ 500 RPM
Vol.	1 pt. 20 sec. @ 500 RPM
Vac.	6" @ 500 RPM

Filter (disposable element type) in line between fuel pump and carb. Replace every 12,000 miles or as required.

Filter (fuel tank) End of sender unit-Self cleaning.

SPARK PLUGS

Autolite	8F42
Gap	.032"-.036"
Torque	15-20 Ft/Lbs.
Rotor air gap voltage drop	7.5KV (Max)

CARBURETOR

Manual Trans.	Autolite 2100-C9AF9510BD
Auto. Trans.	Autolite 2100
Cable linkage	C9AF9510A
Rod linkage	C9ZF9510G

Duct. and valve assy.-Engine comp. temp. less than 100°F-Valve plate should be in the heat on position-185°F valve plate should be in the heat off position-Engine at idle RPM-Vac. motor aux. air inlet valve should be fully closed. Disconnect vac. hose at motor-inlet valve should move to the full open position. Engine vac. at hose should be 15" min.

DISTRIBUTOR

	Manual Trans.	Auto. Trans.
FoMoCo	C8AF12127E	C9AF12127N
Rotation	CC	CC
Spring Tension (oz)	17-21	17-21
Gap (inch)	.021	.017
Dwell (Degrees)	24-29	26-31
Variation (Degrees)	6	6

(set dwell to 26-1000 RPM 0" vac.)
At constant speed apply 0" vac. to max. vac.

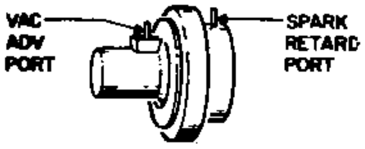
Condenser Capacity .21-.25 MFD

MECHANICAL ADVANCE

C8AF12127E Dist. RPM	C8AF12127E Dist. Deg.	C9AF12127N Dist. RPM	C9AF12127N Dist. Deg.
350	0-½	350	0-½
500	0-1¾	500	1¾-3¾
750	4¾-6¾	750	5½-7½
1000	6-8¼	1000	6-8¼
1500	8-10¼	1500	7¼-9½
2000	10-12½	2000	8¼-10¾
2350	max. 14		

VACUUM ADVANCE

In. Vac.	Dist. Deg.	In. Vac.	Dist. Deg.
5	0-¾	5	0-1
10	0-3	10	3½-6¾
15	5½-8½	15	7½-10½
20	8½-11	20	0-11½
25	8½-11	20	max. 11½
25	max. 11		



VACUUM RETARD

In. Vac.	Dist. Deg.	In. Vac.	Dist. Deg.
5	0-1		NONE
10	2-5¾		
15	5-6		
20	5-6		
20	max. 6		

IGNITION COIL (ohms @ 75°F)

FoMoCo	FAC 12029A
Pri. Res.	1.40-1.54
Sec. Res.	7600-8800
Test Set Line	7
Ballast Resistor Loom	1.3-1.4

IGNITION CURRENT

Engine Stopped	4.5A
Idling	2.5A

Coil to ground resistance .25 volts max. Voltmeter connected, pos. lead to dist. terminal of coil, neg. lead to engine grd. Breaker points closed and ignition switch in the IGN position.

HI TENSION WIRE RESISTANCE

1000 Ohms per inch

CRANKING CIRCUIT RESISTANCE

Insulated Circuit

Bat. Pos. Post to Starter Bat. Term.	.5v
(Pos. cable to starter relay	.1v)
(Relay contacts only	.2v)
(Relay cable to starter	.2v)

Ground Circuit

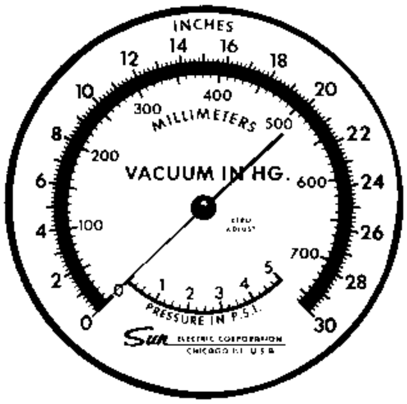
Eng. Grd. to Neg. Bat. Post	.1v

STARTER FREE RUNNING CURRENT DRAW

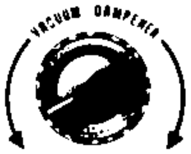
70A @ 12v

VACUUM GAUGE

The vacuum gauge is used to measure engine intake manifold vacuum. You can use it to measure the vacuum during cranking, to indicate mechanical problems in the engine, and at idle to indicate mechanical problems and incorrect timing. It is also used in some procedures as an indicator of idle mixture setting. At high engine speed it can indicate a restriction in the exhaust system. The vacuum gauge may also be used to check the amount of vacuum produced by auxiliary sources of vacuum, such as a vacuum booster pump, to test the efficiency of a fuel pump and to determine the amount of vacuum in control circuits for various accessories such as vacuum operated headlight covers.



The vacuum gauge uses the black rubber hose lead. A VACUUM DAMPER is fitted to some models and is turned to damp out excessive needle oscillations. Other models have an internal, non-adjustable damper to accomplish this damping action. Accessory fittings, hoses, tees and screw-in adapters are used to connect the test hose to the source of manifold vacuum.



AREA TESTS

CRANKING VACUUM

Make this test to detect problems such as burnt valves, broken rings, blown head gaskets or cracked heads or block, which might affect compression.

1. Connect the vacuum hose to a source of intake manifold vacuum. Use Tee adapter, hoses or screw-in adapter as required.
2. Ground the coil high tension lead so the engine will not start. If the vehicle has a non-standard ignition system, refer to the manufacturer's procedure.
3. Crank the engine and note the action of the vacuum gauge. If the vacuum is very low, less than 1" it may be necessary to back out the idle speed control or disconnect the electrical throttle stop solenoid in order to increase cranking vacuum to a higher, more readable level.

   GOOD A steady vacuum reading that is even and has a rhythmic pulsation indicates a mechanically sound engine.

   BAD A compression leak will cause the vacuum gauge to drop toward zero each time the bad cylinder is on its intake stroke. Test this engine using the cylinder leakage and compression testers to pinpoint the compression loss.

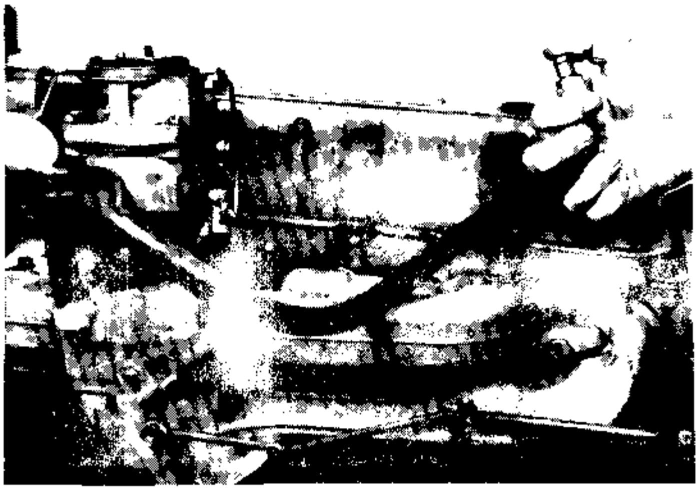
PCV TEST

Make this test to determine if PCV system is working properly.

1. While cranking the engine, pinch the PCV hose or close the end of the PCV valve to prevent air from leaking into the intake manifold.
2. Watch the vacuum gauge.

   GOOD An increase in vacuum indicates a good PCV system.

   BAD Very little or no change in vacuum indicates a bad PCV system. Replace the PCV valve and be sure the PCV hose is clear.



IDLE VACUUM

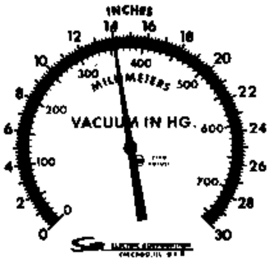
Make this test to determine if there are any problems with compression leak in the cylinders, or in take manifold or sticking valves, improper timing or fuel mixture which may affect idle vacuum.

1. Reconnect high tension coil lead. Readjust the idle speed control or reconnect any idle stop solenoids disconnected during the cranking tests.
2. Start the engine and run at a specified idle RPM.

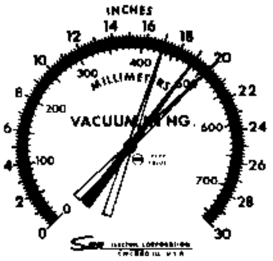
   GOOD A steady vacuum (between 15" to 22") indicates the engine is in good condition and is operating normally.

   BAD A pulsating or low vacuum indicates problems in the mechanical, ignition or fuel systems. Run additional tests using the cylinder leakage tester to pinpoint the problems.

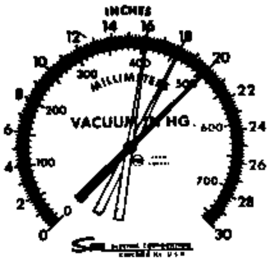
Low steady vacuum indicates manifold leak or incorrect timing.



Needle moves back and forth indicates carburetor mixture is incorrect.



Regular needle pulses compression loss in one or more cylinders.



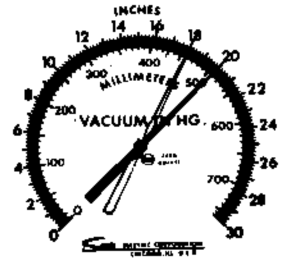
IDLE MIXTURE

Make this test to adjust the idle mixture screw for proper mixture on pre-emission control engines only. For emission control vehicles, follow the manufacturer's procedures for setting and testing.

1. Set the idle speed to the specified idle RPM by adjusting the idle speed screw.
2. Peak the vacuum reading by adjusting the idle mixture screw or screws. Hold the idle RPM to specifications by adjusting the idle speed screw.
3. Evaluate the results with the combustion efficiency meter.

EXHAUST RESTRICTION

Make this test to determine if a serious exhaust restriction due to a plugged tail pipe, collapsed muffler or header pipe exists.



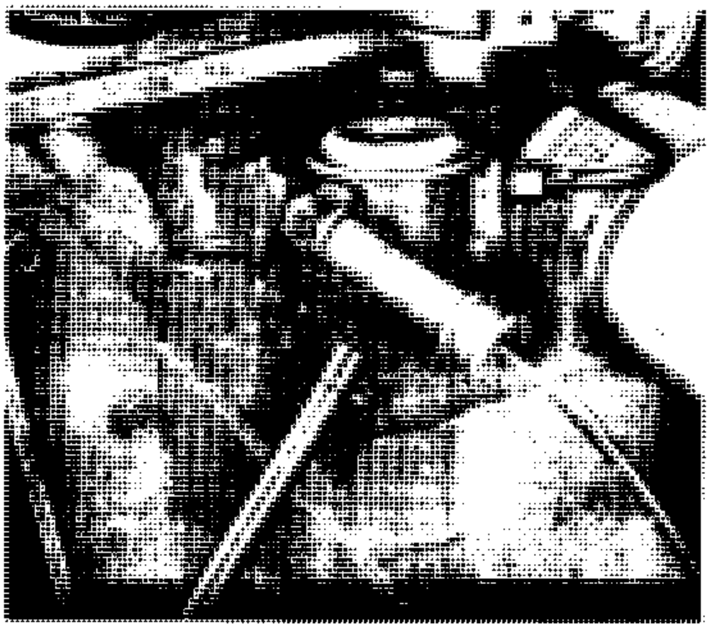
1. Run the engine at idle RPM and note the vacuum reading.
2. Increase the engine speed to 2500 RPM and note reading.

GOOD An increase in vacuum over idle vacuum indicates no restrictions in the exhaust system.

BAD A decrease in vacuum indicates a restriction in the exhaust system which will affect performance.

DETAIL TESTS
FUEL PUMP VACUUM TEST

Make this test to determine if the fuel pump develops enough vacuum to pull fuel from the tank and if the check valves in the pump are working properly.



1. Disconnect input fuel line from fuel pump.
2. Connect vacuum hose to input of fuel pump. Use an adapter as necessary.
3. Start the engine and run at idle or specified RPM.
4. Watch the vacuum gauge. It may require several minutes for fuel level in carburetor float bowl to drop sufficiently to cause the fuel pump to operate. If the FUEL PUMP TESTER is connected, this may be speeded up by placing the volume hose into a container and opening the clamp. Allow the vacuum gauge to reach the maximum reading.
5. Stop the engine. Watch the vacuum gauge.

GOOD Vacuum gauge reads within specifications if listed or at least 10" if not listed and holds this reading for at least 30 seconds.

BAD If the vacuum is below specification or less than 10", if not specified, or the vacuum reading does not hold for 30 seconds, then problems in the fuel pump such as a leaking diaphragm or bad check valves are indicated.

VACUUM BOOSTER TEST

Make this test to determine if the vacuum booster or auxiliary source of vacuum produces sufficient vacuum.

1. Connect vacuum hose to input port of booster.

2. Operate engine at idle and note vacuum reading.

   GOOD Above minimum operating specification of booster or if not specified above 8".

   BAD If below the specified amount then repair or replace the booster.

VACUUM OPERATED ACCESSORIES

Make this test to determine if sufficient vacuum is applied to operate the accessories.

1. Connect vacuum hose to control lines using TEE fitting and short length of hose.
2. Run engine at idle.
3. Operate accessory and watch vacuum gauge.

   RESULTS See the manufacturer's shop manual for minimum vacuum required for operation. If below minimum check for leaks in the lines.

Name ____________________

COMPRESSION SYSTEM TESTING WORKSHEET

Eng. No. ________________ Make/Year ____________________

AREA TESTS Tests to quickly determine an engine's condition.

	GOOD	BAD
CRANKING VACUUM (Steady reading)	☐	☐
PCV TEST (Increase in cranking vacuum with PCV pinched)	☐	☐
IDLE VACUUM (Steady vacuum, 15" to 22") ______________"	☐	☐
EXHAUST RESTRICTION (Vacuum increases at higher RPM)	☐	☐
CYLINDER BALANCE (Less than 30 RPM difference)	☐	☐

Cylinder #								
RPM								

RPM at start ____________
RPM at end ____________
(no change in RPM) ____________

DETAIL TESTS Tests to pinpoint the problem.

	GOOD	BAD
COMPRESSION (Within specifications)	☐	☐

Cylinder #								
PSI								

Specifications (from card):
__________PSI
__________Variation

	GOOD	BAD
CYLINDER LEAKAGE No leakage at valves or head gasket, less than 20% leakage	☐	☐

Cylinder #								
% Leakage								

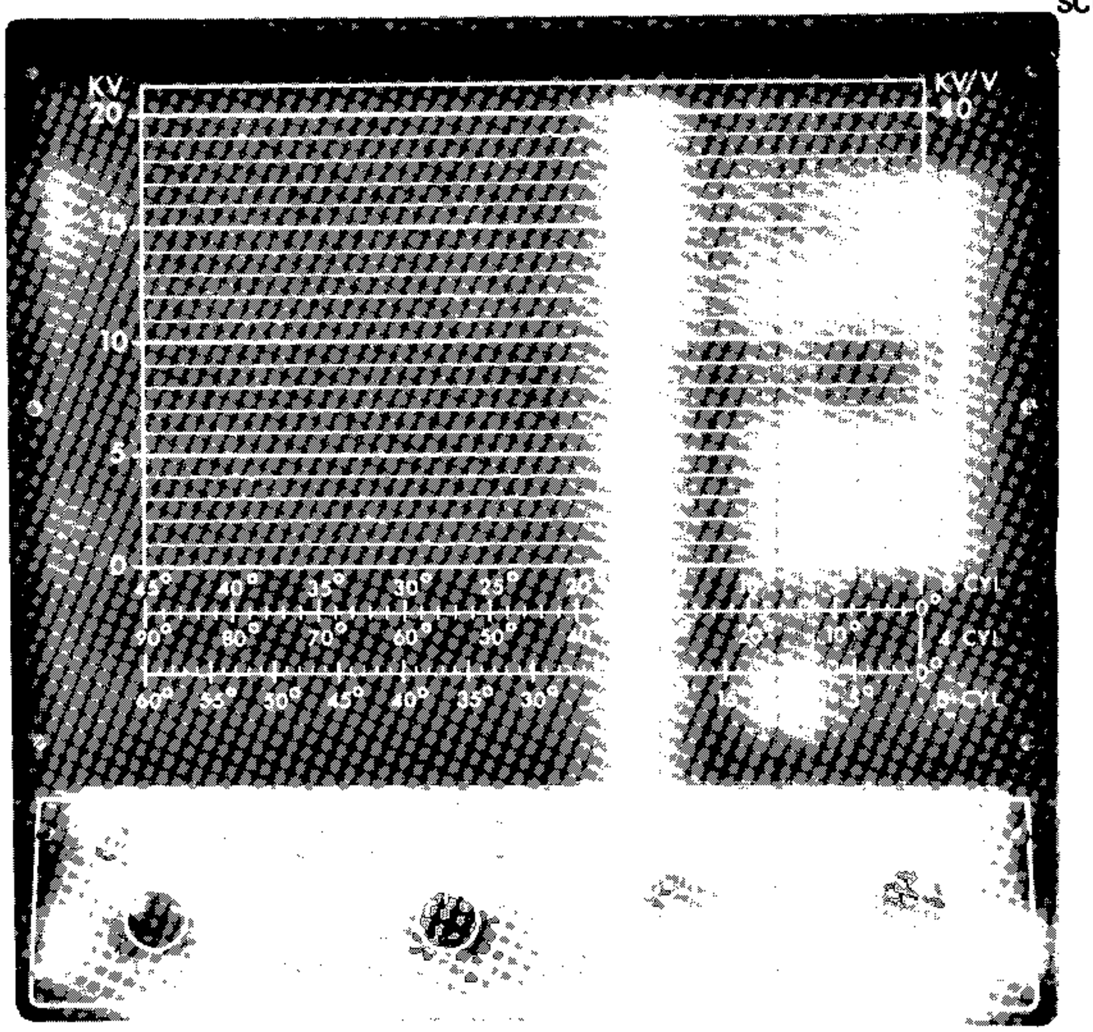
Indicate location of leakage:

I - intake valve

E - exhaust valve

H - head or head gasket

R - piston rings



SUN SCOPE CONTROLS
SS-400

The controls of the Sun Scope are used to select what circuit is to be seen, how the trace will be shown on the screen, and the size of the trace. The shape of the trace is controlled only by the changes in the voltage in the circuit not by any of the controls. During most scope testing only two controls are used. The CIRCUIT SELECTOR which determines which circuit is to be seen and the PATTERN SELECTOR which determines how the pattern is to be shown. The remaining controls are adjusted only when first setting up the scope.

BASIC SETTING, MODEL SS-400

Follow these steps to obtain a trace of the secondary ignition circuit.

1. Turn the TESTER A. C. switch on.
2. Turn the PATTERN SELECTOR knob to the DISPLAY position. (The Pilot light should be on).
3. Turn the CIRCUIT SELECTOR knob to the SECONDARY position.

Turn the SECONDARY PATTERN HEIGHT knob to the 40-KV position.

5. Turn the BRIGHTNESS CONTROL knob until a bright pattern line appears.
6. Turn the VERTICAL CONTROL knob until the pattern is on the 0-KV line of the scope.
7. Turn HORIZONTAL CONTROL knob until left end of the pattern is on the left margin line.
8. Turn the PATTERN LENGTH CONTROL knob until the right end of the pattern is on the right margin line.
9. Readjust the HORIZONTAL CONTROL knob and the PATTERN LENGTH CONTROL knob as needed after the engine is started.

Follow these steps to obtain a trace of the primary ignition circuit.

1. Turn the PRIMARY PATTERN HEIGHT knob to the 400 V position.
2. Turn the CIRCUIT SELECTOR knob to the PRIMARY position.

FUNCTION OF THE CONTROLS

The PATTERN SELECTOR knob changes the way the ignition system operation is shown on the screen. There are three ways to look at the ignition system on a Sun Scope. In the DISPLAY position, each cylinder follows the other across the screen according to the firing order. In the RASTER position, the cylinders are placed one above the other for easier viewing. In the SUPERIMPOSED position, the cylinders are placed one in front of the other, so that anything unusual can be seen.

The CIRCUIT SELECTOR knob lets you see primary and secondary ignition operation. Two primary positions are provided for positive and negative ground systems.

The SECONDARY PATTERN HEIGHT knob controls the size of the secondary pattern. When in the 40-KV position you read the scale on the right side of the screen. When in the 20-KV position read the scale on the left side of the screen. Remember you are reading Kilovolts or thousands of volts. KV means 1000-Volts.

The BRIGHTNESS CONTROL knob adjusts the intensity of the pattern.

The VERTICAL CONTROL knob raises and lowers the pattern on the screen.

The HORIZONTAL CONTROL adjusts the horizontal position of the pattern.

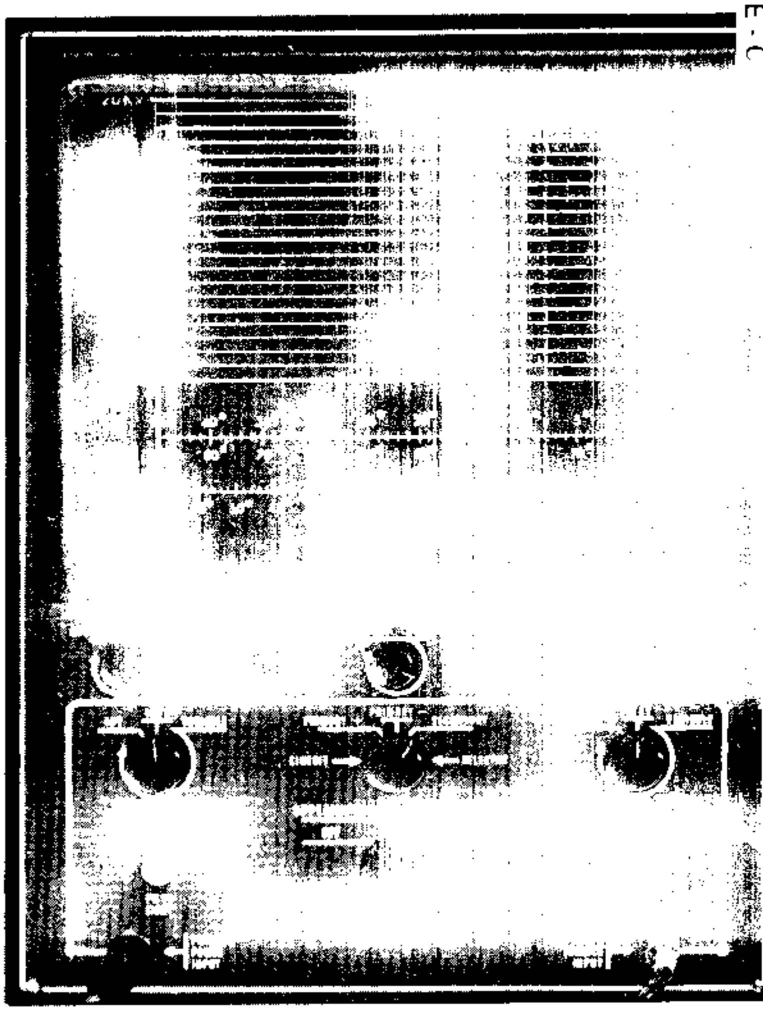
The PATTERN LENGTH knob adjusts the horizontal length of the pattern.

The PRIMARY PATTERN HEIGHT knob lets you control the size of the primary pattern. When in the 400-VOLT position, you read the scale on the right side of the screen. Since the scale only goes from 0 to 40, you have to add a zero when reading this scale. When in the 40-VOLT position, you read the number directly.

The RASTER SPACING knob adjusts the spacing between individual cylinder patterns when the Pattern Selector is in Raster position.

SUN SCOPE CONTROLS
MODELS SS-100 and SS-110

The controls of the Sun Scope are used to select what circuit is to be seen, how the trace will be shown on the screen, and the size of the trace. The shape of the trace is controlled only by the changes in the voltage in the circuit not by any of the controls. During most scope testing only two controls are used. The CIRCUIT SELECTOR which determines which circuit is to be seen and the PATTERN SELECTOR which determines how the pattern is to be shown. The remaining controls are adjusted only when first setting up the scope.



BASIC SETTING

Follow these steps to obtain a trace of the secondary ignition circuit.

1. Turn the TESTER A. C. switch on.
2. Turn the PATTERN SELECTOR knob to the DISPLAY position. (The Pilot light should be on).
3. Turn the CIRCUIT SELECTOR knob to the SECONDARY position.
4. Turn the SECONDARY PATTERN HEIGHT knob to the 40-KV position.
5. Turn the BRIGHTNESS CONTROL knob until a bright pattern line appears.
6. Turn the VERTICAL CONTROL knob until the pattern is on the 0-KV line of the scope.
7. Turn HORIZONTAL CONTROL knob until left end of the pattern is on the left margin line.
8. Turn the PATTERN LENGTH CONTROL knob until the right end of the pattern is on the right margin line.
9. Readjust the HORIZONTAL CONTROL knob and the PATTERN LENGTH CONTROL knob as needed after the engine is started.

Follow these steps to obtain a trace of the primary ignition circuit.

1. Turn the PRIMARY PATTERN HEIGHT knob to the 400 V position.
2. Turn the CIRCUIT SELECTOR knob to the PRIMARY position.

FUNCTION OF THE CONTROLS

The PATTERN SELECTOR knob changes the way the ignition system operation is shown on the screen. There are three ways to look at the ignition system on a Sun Scope. In the DISPLAY position, each cylinder follows the other across the screen according to the firing order. In the RASTER position, the cylinders are placed one above the other for easier viewing. In the SUPERIMPOSED position, the cylinders are placed one in front of the other, so that anything unusual can be seen.

The CIRCUIT SELECTOR knob lets you see primary and secondary ignition operation. Two primary positions are provided for positive and negative ground systems.

The SECONDARY PATTERN HEIGHT knob controls the size of the secondary pattern. When in the 40-KV position you read the scale on the right side of the screen. When in the 20-KV position read the scale on the left side of the screen. Remember you are reading Kilovolts or thousands of volts. KV means 1000-Volts.

The BRIGHTNESS CONTROL knob adjusts the intensity of the pattern.

The VERTICAL CONTROL knob raises and lowers the pattern on the screen.

The HORIZONTAL CONTROL adjusts the horizontal position of the pattern.

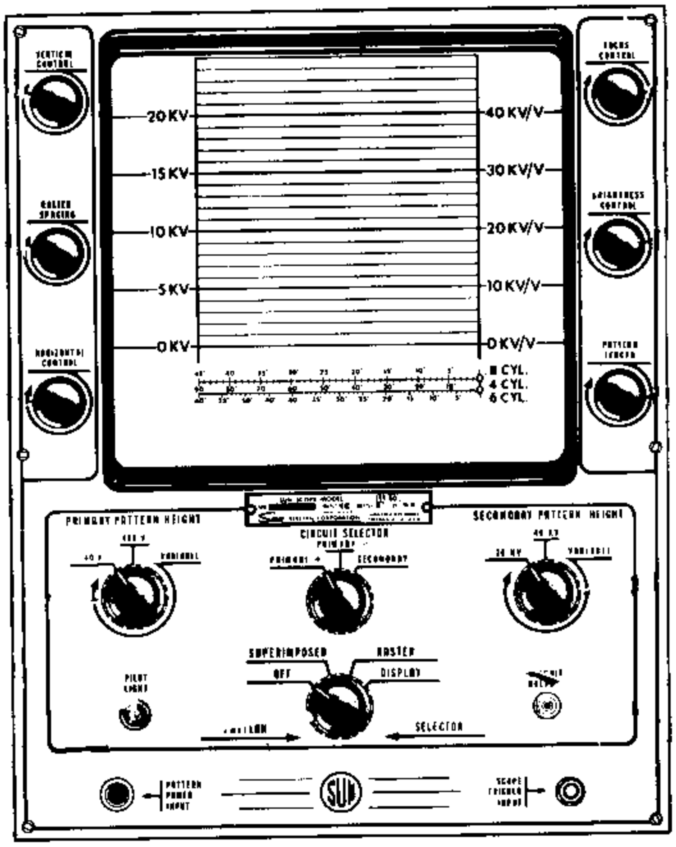
The PATTERN LENGTH knob adjusts the horizontal length of the pattern.

The PRIMARY PATTERN HEIGHT knob lets you control the size of the primary pattern. When in the 400-VOLT position, you read the scale on the right side of the screen. Since the scale only goes from 0 to 40, you have to add a zero when reading this scale. When in the 40-VOLT position, you read the number directly.

The RASTER SPACING knob adjusts the spacing between individual cylinder patterns when the Pattern Selector is in Raster position.

SUN SCOPE CONTROLS
MODELS SS-87 SS-95

The controls of the Sun Scope are used to select what circuit is to be seen, how the trace will be shown on the screen, and the size of the trace. The shape of the trace is controlled only by the changes in the voltage in the circuit and not by any of the controls. During most scope testing only two controls are used. The CIRCUIT SELECTOR which determines which circuit is to be seen and the PATTERN SELECTOR which determines how the pattern is to be shown. The remaining controls are adjusted only when first setting up the scope.



BASIC SETTINGS

Follow these steps to obtain a trace of the secondary ignition circuit.

1. Turn the TESTER A. C. Switch on.
2. Turn the PATTERN SELECTOR knob to the display position. (The Pilot light should be on).
3. Turn the CIRCUIT SELECTOR knob to the secondary position.
4. Turn the SECONDARY PATTERN HEIGHT knob to the 40-KV position.
5. Turn the BRIGHTNESS CONTROL knob full clockwise.
6. Turn the HORIZONTAL CONTROL knob full clockwise.
7. Turn the VERTICAL CONTROL knob until a bright line appears.
8. Turn the FOCUS CONTROL until the trace is sharp.
9. Turn the VERTICAL CONTROL knob until the pattern is on the 0-KV line of the scope.
10. Turn the HORIZONTAL CONTROL knob until the left end of the pattern is on the left margin line.
11. Turn the PATTERN LENGTH CONTROL knob until the right end of the pattern is on the right margin line.
12. Readjust the HORIZONTAL CONTROL knob and the PATTERN LENGTH CONTROL knob as needed after the engine is started
13. Readjust the BRIGHTNESS CONTROL knob to obtain desired brilliance.

Follow these steps to obtain a trace of the primary ignition circuit.

1. Turn the PRIMARY PATTERN HEIGHT knob to the 400V position.
2. Turn the CIRCUIT SELECTOR knob to the PRIMARY position.

FUNCTION OF THE CONTROLS

The PATTERN SELECTOR knob changes the way the ignition system operation is shown on the screen. There are three ways to look at the ignition system on a Sun Scope. In the DISPLAY position, each cylinder follows the other across the screen according to the firing order. In the RASTER position, the cylinders are placed one above the other for easier viewing. In the SUPERIMPOSED position, the cylinders are placed one in front of the other, so that anything unusual can be seen.

The CIRCUIT SELECTOR knob lets you see primary and secondary ignition operation. Two primary positions are provided for positive and negative ground systems.

The SECONDARY PATTERN HEIGHT knob controls the size of the secondary pattern. When in the 40-KV position you read the scale on the right side of the screen. When in the 20-KV position read the scale on the left side of the screen. Remember you are reading Kilovolts or thousands of volts. KV means 1000-Volts.

The BRIGHTNESS CONTROL knob adjusts the intensity of the pattern.

The VERTICAL CONTROL knob raises and lowers the pattern on the screen.

The HORIZONTAL CONTROL adjusts the horizontal position of the pattern.

The PATTERN LENGTH knob adjusts the horizontal length of the pattern.

The PRIMARY PATTERN HEIGHT knob lets you control the size of the primary pattern. When in the 400-VOLT position, you read the scale on the right side of the screen. Since the scale only goes from 0 to 40, you have to add a zero when reading this scale. When in the 40-VOLT position, you read the number directly.

The RASTER SPACING knob adjusts the spacing between individual cylinder patterns when the Pattern Selector is in Raster position.

The FOCUS CONTROL knob adjusts the sharpness of the trace.

SUN SCOPE
HOOK UP

The Sun scope uses only two cables to connect the scope to the engine's ignition system.

The cable is the Pattern pick-up and is connected to the primary ignition circuit at the coil's distributor terminal and to the secondary circuit at the coil's high tension tower. The trigger lead is used to trigger the scope so the pattern follows the firing order and is connected to the NO.1 Spark plug.

BASIC HOOK UP

Follow these steps to obtain a trace of both the secondary and primary ignition circuits on conventional ignition systems.

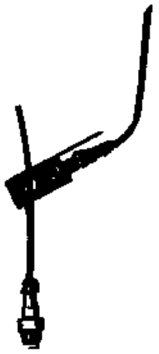
TESTERS WITH CLAMP-ON PICK-UPS

1. Clamp the Pattern Pick-up around the coil's high tension lead.:
   a. For cranking tests, remove the coil high tension lead from the distributor center tower. Position lead so it does not touch ground or the case of Pattern Pick-up.
   b. For running tests, do not remove the coil high tension lead.
2. Connect the Red clip to the coil's distributor terminal.
3. Connect the Black clip to a good engine ground.
4. Clamp the Trigger Pick-up around the NO.1 spark plug lead near the distributor cap. If another cylinder is used for timing, clamp the lead around that cylinder's spark plug lead.

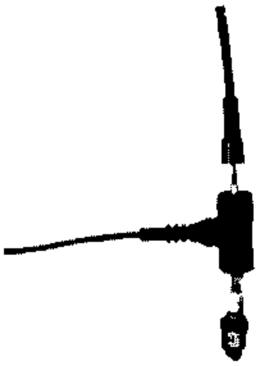
NOTE: If erratic tachometer operation and/or the scope mistriggers, check that the Trigger Pick-up Clamp surfaces are clean and firmly closed. If the problem persists, try the Trigger Pick-up on another cylinder. If the problem is corrected, then replace NO.1 spark plug lead, move Trigger Pick-up back and continue test.

TESTERS WITH PLUG-IN PICK-UPS

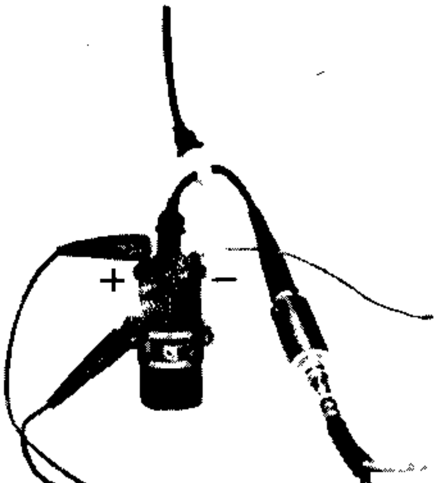
1. Remove the coil to distributor high tension lead from the coil tower.
2. Put the Pattern Pick-up Lead into the coil tower.
   a. For cranking tests, do not put the high tension lead into the pick-up adapter.
   b. For running tests, put the high tension lead into pick-up adapter.
3. Connect the Red clip lead to the coil's distributor terminal.



Trigger lead to:
Models SS-110, 400



Trigger lead for
Models SS-95, 87, 100

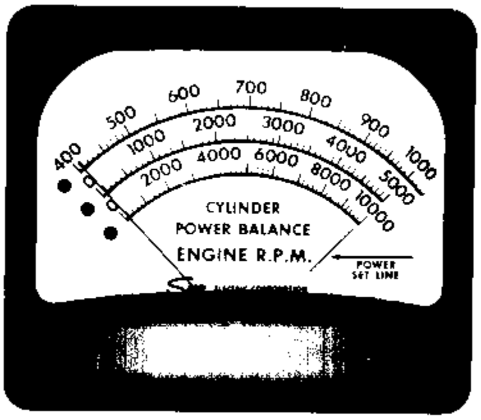


4. Connect the Black clip lead to an engine ground.
5. Connect the trigger lead to the spark plug circuit of NO. 1 cylinder, or the timing cylinder if other than NO. 1.

CYLINDER POWER BALANCE
USED ON MODELS EET-1160, 945, 947

The Cylinder Power Balance Tester is used to check all cylinders of an engine, to see that they are producing equal power. This test is used to determine if there are any mechanical, ignition, or fuel system problems which will cause an uneven power output from cylinder to cylinder.

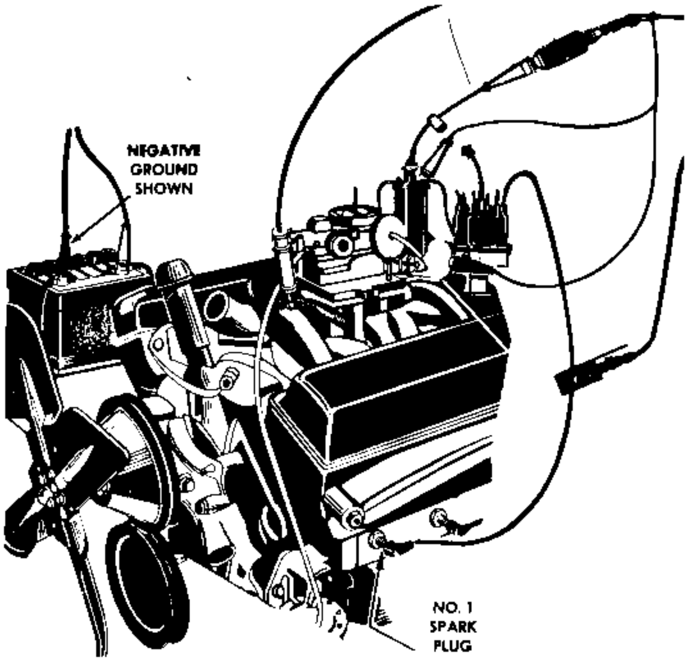
This tester uses the CYLINDER POWER BALANCE push-buttons and the Tachometer.

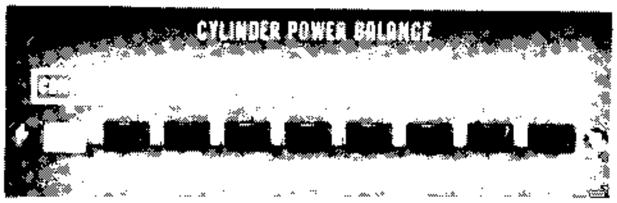


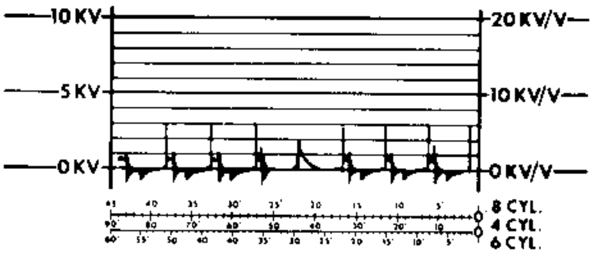
POWER BALANCE

Make this test to determine if there are any problems in the engine which affect power output, by comparing the POWER BALANCE between cylinders.

1. Connect the secondary and primary Scope pattern pick-up leads to the engine.
2. Connect the trigger pick-up lead to the No. 1 spark plug wire.
3. Set the RPM switch to 1000 or AUTO and the cycle switch to the proper position.
4. Set the CYLINDER switch to the correct number of cylinders.
5. Start engine and allow it to warm-up
6. Set the engine speed to any steady speed between 800 and 1000 RPM. Record the RPM.
7. Press the 1st button to short out the number 1 cylinder. Record the RPM at which the engine is now running
8. Press the "1 st" button again to return the cylinder to operation.
9. Repeat steps 7 and 8 for each cylinder in the engine, pausing long enough to record the RPM for each cylinder.
   The CANCEL button may be used in place of pressing each cylinder button a second time.







Appearance of scope pattern with one cylinder shorted out.

10. Compare RPM figures recorded in Steps 7 and 8.

GOOD less than 30 RPM difference between cylinders.

BAD more than 30 RPM difference indicates an engine with unequal power output from the cylinders. Check the mechanical system using the Cylinder Leakage tester, the ignition system using the Sun Scope, and the Fuel System with the Combustion Efficiency tester or Infra-Red Tester.

CYLINDER POWER BALANCE
USED ON MODELS EET-920, 1120

The Cylinder Power Balance Tester is used to check if all cylinders of an engine are producing equal power. This test is used to determine if there are any mechanical, electrical or fuel system problems which will cause an uneven power output from cylinder to cylinder.

This tester uses the ELECTRO CYLINDER SELECTOR, the Sun Scope and the Tachometer.

AREA TEST

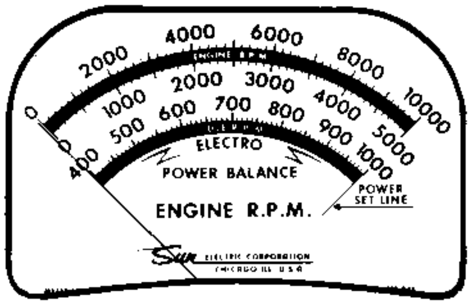
POWER BALANCE

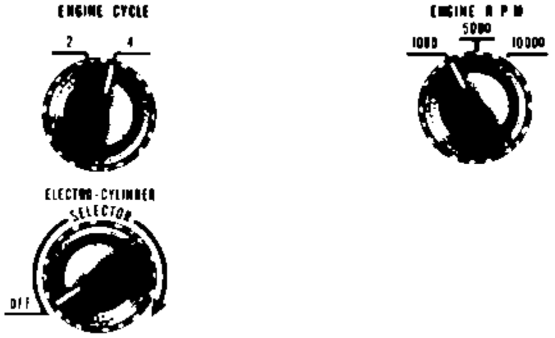
Make this test to determine if there are any problems in the engine which affect power output, by comparing the power balance between cylinders.

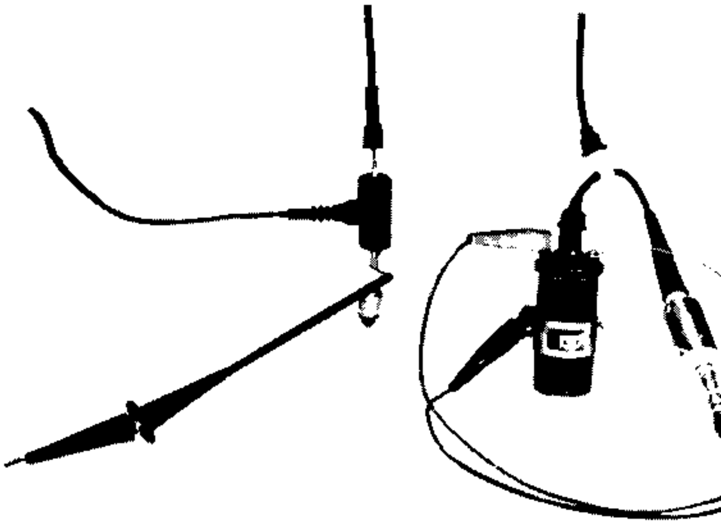
1. Connect the secondary and primary Scope pattern pick-up leads to the engine.
2. Connect the trigger pick-up lead to the NO. 1 cylinder spark plug.
3. Set the ENGINE RPM knob to 1000 and the ENGINE CYCLE knob to the proper position.
4. Start the engine and allow it to warm up.
5. Set the engine speed to any speed between 800 and 1000 RPM. Record this RPM.
6. Short out cylinder NO. 1 with the grounding probe by touching the end of the probe to the top of the spark plug. Record the RPM at which the engine is now running.
7. Use the ELECTRO CYLINDER SELECTOR knob to short out each of the remaining cylinders in turn. Be sure the dip in the trace is positioned directly over where the firing line was. Record the RPM for each cylinder.
8. Turn the ELECTRO CYLINDER SELECTOR back to OFF. Note the RPM. This should be the same as in step 5. If not, the test must be repeated.
9. Compare the RPM'S recorded in steps 6 and 7.

   GOOD Less than 30 RPM difference between cylinders.

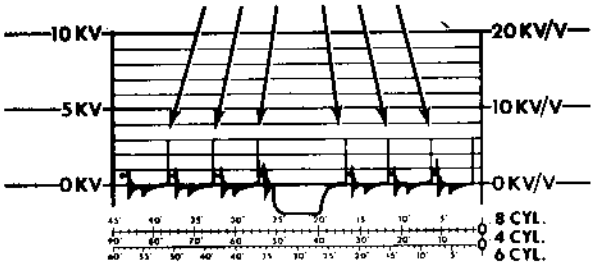
   BAD More than 30 RPM difference indicates an engine with unequal power output from each cylinder due to problems in the compression, ignition or fuel systems. Check the compression system using the Cylinder Leakage tester, the ignition system using the Sun Scope and the fuel system with the Combustion Efficiency tester.







FIRING LINES

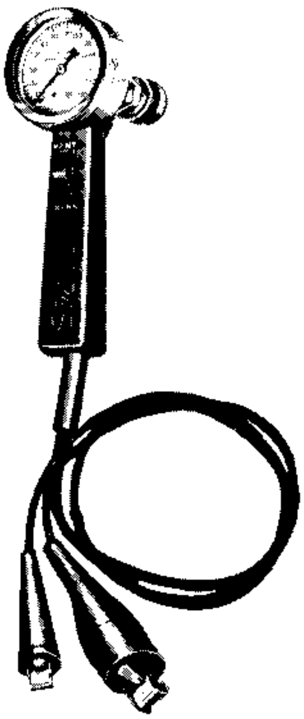


Appearance of scope pattern with one cylinder shorted out.

COMPRESSION TESTER

The Compression Tester measures the amount of pressure built up in a cylinder while cranking during the compression stroke. The tester can indicate losses in compression through the rings, valves, or head gasket. It will also show excessive carbon build up in cylinders.

The compression tester uses a hand held gauge with a CRANK-VENT switch to allow remote cranking of an engine. The threaded tester hoses are used to connect the gauge to the engine. These hoses have a special rubber ring that makes a positive seal in the spark plug hole with only hand tightening.



COMPRESSION TEST

Make this test to detect compression leaks as indicated by the vacuum or cylinder balance tests. Compression testing can also detect excessive carbon build-up in a cylinder.

1. The engine should be at normal operating temperature for this test.
2. Remove all the spark plugs.
3. Set throttle and choke wide open.
4. Ground out the coil's high tension lead and turn the ignition switch ON. If the vehicle has a non-standard ignition system, refer to manufacturer's procedure. Be sure the vehicle's battery has a sufficient charge to crank the engine at a normal speed.
5. Connect the tester's electrical leads to the starter solenoid or the control circuit.
6. Screw the proper test hose into the spark plug hole and connect the other end to the tester.
7. Crank the engine for 4 compression strokes; note the first and last reading.
8. Vent the compression tester and move to the next cylinder.

   GOOD Compression pressures on final stroke are within the specified range.

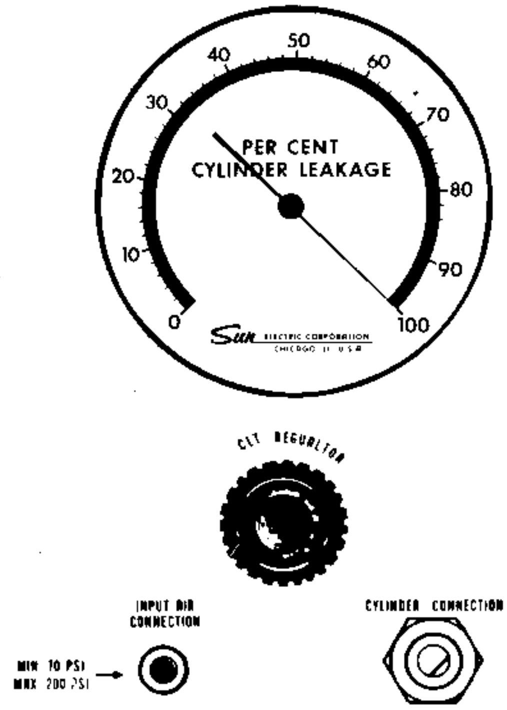
   BAD First stroke reading is low and pressure does not build to a good reading in the following strokes. Add a little oil to the cylinder and repeat the test. If readings are now good, the test indicated ring problems. If readings are still low then the test indicated either a valve or a head gasket problem. Inspect the spark plug for evidence of oil or water and test adjacent cylinders for similiar problems. Readings higher than normal indicate carbon build up in the cylinder.

CYLINDER LEAKAGE TESTER

The Cylinder Leakage Tester is used to determine the location and relative amounts of compression losses in an engine. This tester can locate leaks at intake and exhaust valves or head gaskets and excessive leakage past the rings.

The Cylinder Leakage Tester uses the % Cylinder Leakage gauge, the CLT Regulator, a tester hose and one of several adapter hoses for various types of engines.

The Tester requires an outside source of air pressure (70 to 200 psi) to be connected to the INPUT AIR CONNECTION. Before connecting this line to the input air connection, turn the CLT REGULATOR to the left a couple of turns. Then connect the air line and turn the CLT REGULATOR to the right until the gauge reads "0". Momentarily connect the tester hose to the output fitting. The gauge should rise, then return to "0". If it does not return to zero, turn the CLT REGULATOR to the left again and repeat. When the Cylinder Leakage Tester reads on "0" it is ready to be used. Connect the tester hose to the CYLINDER CONNECTION.



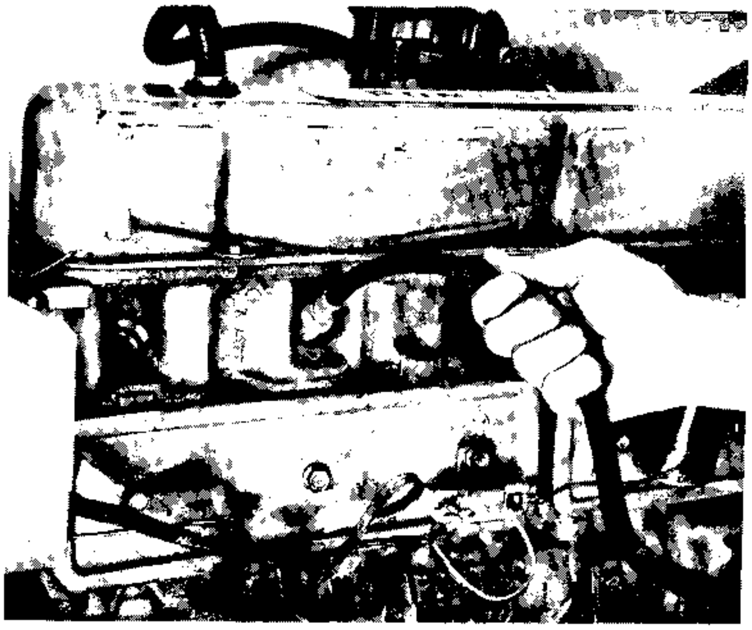
This air pressure will be applied to a cylinder when the piston is at TDC on the compression stroke. At this time both intake and exhaust valves are closed and except for a small amount of air leaking past the piston ring gaps no air should escape from a good cylinder. The amount that does leak out is measured on the % CYLINDER LEAKAGE gauge.

DETAIL TEST

CYLINDER LEAKAGE

Make this test to determine the location of compression losses indicated by the vacuum or cylinder balance tests.

1. Remove spark plugs from cylinders to be tested and radiator and crankcase filler caps.
2. Ground out the coil's high tension lead. If the vehicle has a non-standard ignition system, refer to the manufacturer's procedure.
3. Connect the remote starter switch to the starter solenoid. Turn ignition key ON.
4. Screw the proper adapter hose, finger tight, into the cylinder to be tested and put the whistle on the end of the hose.
5. Crank engine over slowly until whistle stops sounding. Remove whistle.
6. Connect the tester hose to the adapter hose. Watch the engine fan; if it turns, stop. Remove the tester hose and repeat Step 5. DO NOT ATTEMPT TO CRANK ENGINE WITH THE TESTER HOSE CONNECTED.



7. Listen for air leakage at exhaust pipe, radiator and carburetor and from the adjacent cylinders. If the engine has a PCV valve, be sure to pinch off PCV hose when listening at carburetor.

8. Look at gauge, record reading.

   GOOD No "air leaking" heard in exhaust pipe, radiator, carburetor or adjacent cylinders and leakage less than 20% .

   BAD "Air leaking" heard at exhaust pipe, radiator, carburetor, adjacent cylinders or more than 20% leakage on a properly broken in engine, indicates a need for service.

   a. Air escaping at carburetor indicates a leak at the intake valve.

   b. Air escaping at exhaust pipe indicates a leak at the exhaust valve.

   c. Air escaping at radiator filler cap indicates a blown head gasket or cracked block.

   d. Air escaping from adjacent cylinders indicates a blown head gasket or cracked block.

   e. More than 20% leakage with no air leakage past the valves or the head gasket indicates excessive ring clearance.

If additional cylinders are to be tested:

9. Either repeat steps 4 to 6 or use the TDC indicator to bring cylinder to be tested up to the test position.

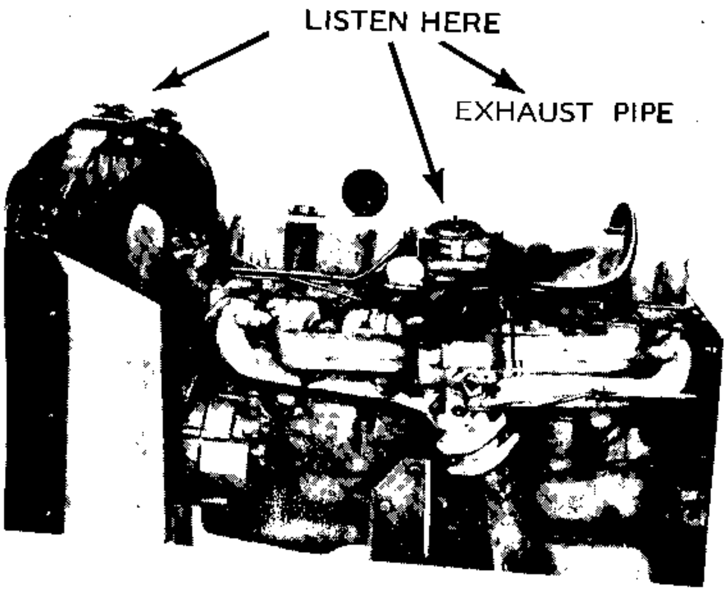
USING THE TDC INDICATOR.

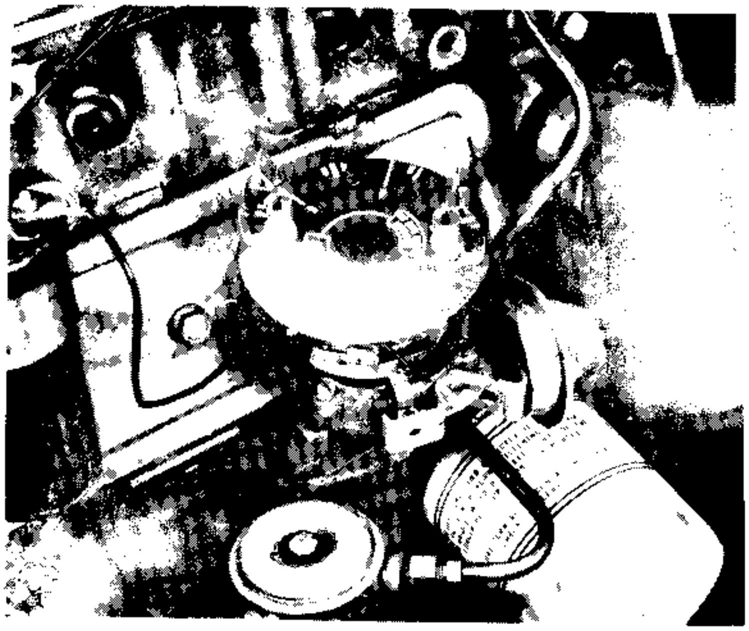
10. Remove the distributor cap and rotor (on window type distributor caps, the rotor is left in place).

11. Put the TDC indicator on end of the distributor shaft.

12. Position the TDC indicator with a reference point, 4, 6, or 8, depending on the engine, lined up with any mark.

13. Crank the engine over slowly until the next reference point (4, 6, or 8) is lined up with the mark. The next cylinder in the firing order is now ready to test.





14. The indicator light, if connected to the distributor terminal of the coil and ground may also be used. When the piston is at TDC on the compression stroke, the ignition points will be open and the light will light.

Name______________________

COMPRESSION SYSTEM TESTING QUIZ

1. The cranking vacuum test is used to:

   A. Set the carburetor idle mixture
   B. Evaluate an engine's general compression condition
   C. Set ignition timing
   D. All of the above

2. A vacuum gauge can tell a mechanic:

   A. The exact location of compression leaks
   B. Cylinder balance or unbalance conditions
   C. Excessive carbon deposits exist in the combustion chamber
   D. All of the above

3. Compression losses at any point during engine operation may cause:

   A. Rough idle
   B. Hard starting
   C. Engine miss
   D. All of the above

4. During the compression test the engine is allowed to crank through how many complete cycles:

   A. One
   B. Two
   C. Three
   D. Four

5. To detect a compression leak while using the cylinder leakage tester:

   A. Use a high voltage probe
   B. Listen at various parts of the engine
   C. Use a kerosene and oil mixture applied to suspected leak areas
   D. All of the above

6. During the cylinder leakage test:

   A. Intake and exhaust valves must be open
   B. Intake and exhaust valves must be closed
   C. Valves may be either open or closed
   D. Intake valve must be open

7. The high tension lead of the coil should be grounded with a jumper wire during which of the following tests:

   A. Compression test
   B. Cranking vacuum test
   C. Idle vacuum test
   D. A and B

8. The power balance test will quickly check the eveness with which each cylinder pulls its share of the load.

   True False

9. All of the spark plugs must be removed before performing a compression test.

   True False

10. Before performing a cylinder leakage test, the spark plugs of the adjoining cylinders should be removed to check for possible head gasket leakage.

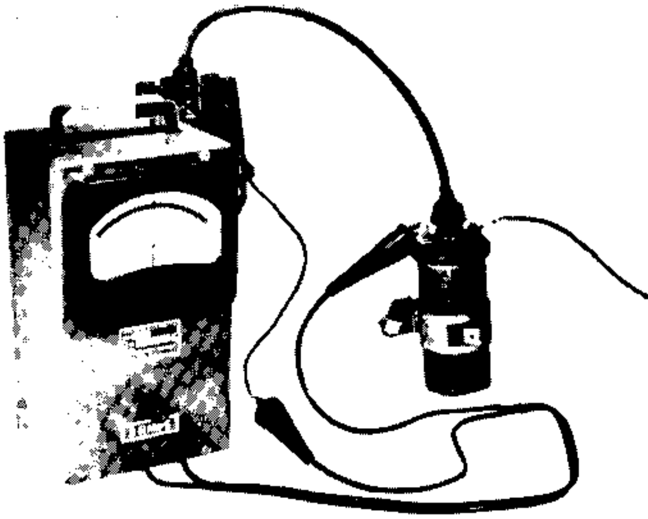
   True False

AMMETER
SUN MODEL GFA-232

The ammeter measures the amount of current flowing in an electric circuit. This Sun Ammeter is used to measure ignition current or the field current of an alternator or generator, or any other current flow of less than 5 amps. This meter is of the center zero type, reading current flow in either direction. The leads, therefore are not color coded and polarity does not matter. A replaceable fuse (5 amp) on the front of the panel protects the ammeter in case of overloads.

DETAIL TESTS

IGNITION CURRENT WITH ENGINE STOPPED



Make this test to determine if improper current flow in the primary ignition circuit is the cause of: low coil output (current flow is too low due to excessive resistance) or contact point burning (current flow is too high due to low resistance in the primary ignition circuit).

1. Open the ignition primary circuit at any point.
2. Connect the ammeter leads so all current in the circuit will flow through the tester.
3. Turn ignition key on. If meter reads zero, bump engine over until the ignition contact points close.

   GOOD   Ammeter reads specified ignition current with engine stopped, or if not specified, about 3.5 to 4 amps.

   BAD   Lower than specified, indicates excessive resistance in the primary circuit components, connections or leads. Higher than specified, indicates lower than normal resistance in the primary circuit components.

IGNITION CURRENT, ENGINE IDLING

Make this test to determine if low coil output or contact point burning is due to improper resistance in the primary circuit while the engine is operating.

1. Start engine and read ammeter.

   GOOD   Ammeter reads specified ignition current with engine idling or if not specified, about 2.5 to 3 amps.

   BAD   Lower than specified, indicates excessive resistance in the primary circuit components, connections or leads. Higher than specified indicates too low a resistance in the primary circuit components.

ALTERNATOR OR GENERATOR FIELD CURRENT

Make this test to determine if the specified amount of current flows in the alternator or generator field circuit when detail testing charging system problems.

1. Connect the ammeter into the alternator or generator's field circuit.
2. Start the engine and operate it at 2000 RPM.
3. Turn on headlights or heater blower and read the meter.

   GOOD Field current within specifications.

   BAD Low current indicates excessive resistance in the alternator or generator's field windings, the regulator or connections. High current indicates shorted or grounded circuits in the alternator, generator, regulator or wiring.

Name ________________________________

ELECTRICAL COMPONENT TESTING WORKSHEET

Eng. No. ______________ Make/Year ______________

GOOD BAD

AMMETER

IGNITION CURRENT ☐ ☐
(within specification)
Spec Measured

engine stopped __________ amp __________ amp
engine idling __________ amp __________ amp

VOLTMETER

CRANKING VOLTAGE AT BATTERY ☐ ☐
(within specification)
Spec ______________ V Measured ______________ V

CHARGING VOLTAGE ☐ ☐
(within specification)
Spec Operating voltage Measured
________ V at ______ F ________ V

CRANKING VOLTAGE AT COIL ☐ ☐
(within Spec or .5V of battery voltage)
Spec ______________ V Measured ______________ V

CIRCUIT RESISTANCE IN THE IGNITION BYPASS CIRCUIT ☐ ☐
(within specification)
Spec ______________ V Measured ______________ V

CIRCUIT RESISTANCE IN A STARTER GROUND CIRCUIT ☐ ☐
(less than .2V)
Spec ______________ V Measured ______________ V

OHMMETER

IGNITION COIL RESISTANCE ☐ ☐
(resistances within spec)
Spec Measured
Primary resistance ______ OHMS ______ OHMS
Secondary resistance ______ OHMS ______ OHMS

SPARK PLUG WIRES (RESISTOR TYPE) ☐ ☐
(within specification)
Spec ________ OHMS Measured
1. ____ 2. ____ 3. ____ 4. ____
5. ____ 6. ____ 7. ____ 8. ____

BALLAST OR IGNITION RESISTOR ☐ ☐
(within specification)
Spec ________ OHMS Measured ________ OHMS

COIL TESTER

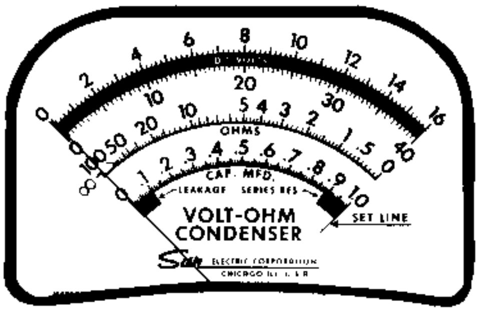
	GOOD	BAD
IGNITION COIL (scope test pattern)	☐	☐

CONDENSER TESTER

	GOOD	BAD
CONDENSER TESTING (within black bands and specifications)	☐	☐

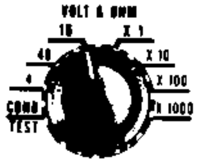
Spec		Measured	
series resistance	black band	good	bad
leakage	black band	good	bad
capacity	______MFD	________MFD	

VOLTMETER



The Voltmeter measures the amount of electric pressure in a circuit. The Sun voltmeter is used to measure the voltage in any battery circuit or the primary ignition circuit of a vehicle.

Examples of useful voltage measurements are cranking voltage, the battery's voltage while cranking the engine, charging voltage, the voltage at which the charging system operates, and applied voltage, the amount of voltage put into a circuit or accessory. In addition, the voltmeter may be used to measure circuit resistance, the amount of voltage lost because of excessive resistance in a circuit.



The Voltmeter uses the twin-flex cable, the Red clip is positive (+) the Black clip is negative (-).

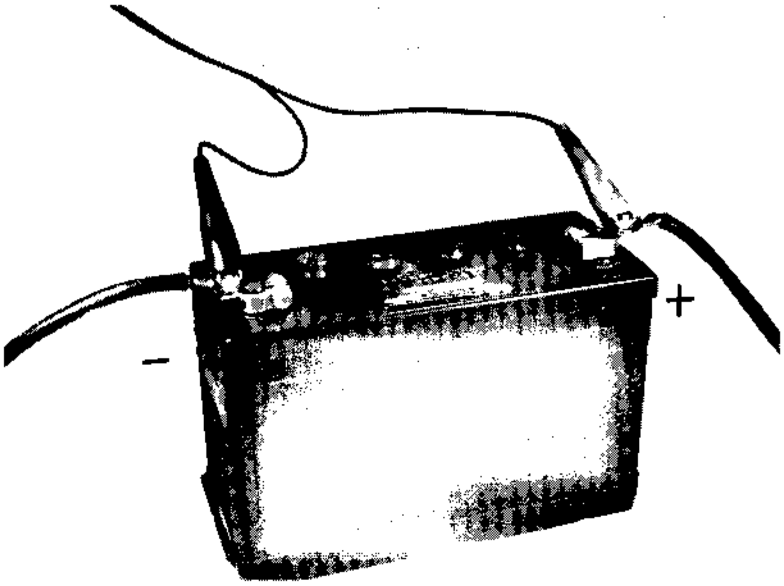
The VOLT & OHM selector knob is used to select the scale or range of voltage being read on the multiple-scale meter.

AREA TESTS

CRANKING VOLTAGE

Make this test to detect problems in the battery, starter motor or starter circuit, leads, connections or starter solenoid which may cause the battery's voltage to drop and cause starting problems.

1. Set the VOLT & OHM control to 16V range, for 6 & 12 volt systems.
2. Connect the Voltmeter leads to the battery, Red to the + terminal, Black to the - terminal.
3. Ground out the coil's high tension lead so the engine will not start. If the vehicle has a non-standard ignition system, refer to the manufacturer's procedure.
4. Crank the engine for five seconds and record Voltmeter reading.



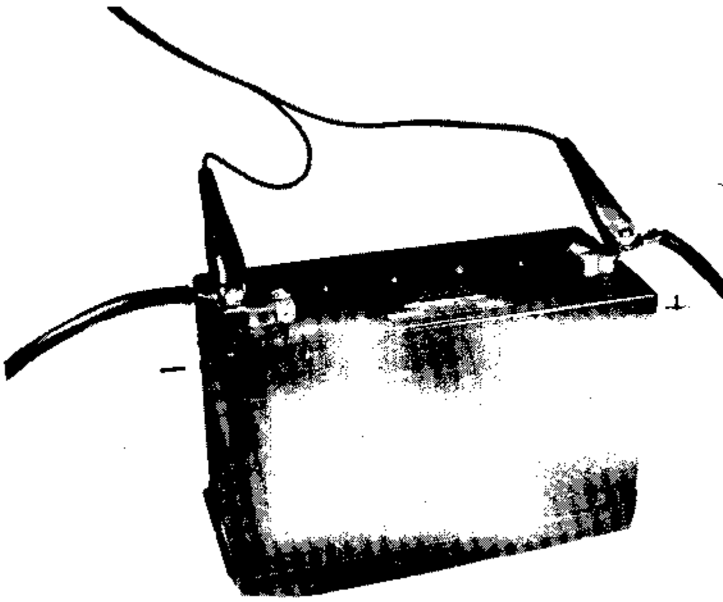
GOOD Voltage remains above minimum specified on specification card or above 9.6 Volts if not specified.

BAD Voltages below specification indicate:

a. The battery is not fully charged or will not accept a charge. Test battery and charging system independently.

b. The starter, the solenoid or the lead connecting them to the battery is the problem.

CHARGING VOLTAGE



Make this test to detect problems in the voltage regulator, generator or alternator or charging system circuit which may prevent proper charging of the battery.

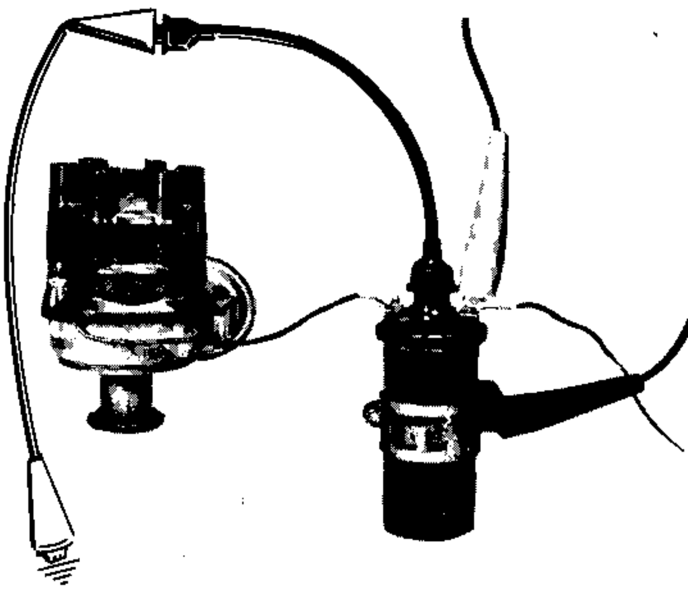
1. Set the VOLT & OHM Selector to 16V.
2. Connect the Voltmeter leads to the battery, Red to + terminal, Black to - terminal.
3. Start the engine and run at 2000 RPM or the specified test speed.
4. Record the voltmeter reading.

GOOD-Voltage within charging system operating voltage specification.

BAD Voltage too low indicates a defective generator or defective or misadjusted regulator. Voltages too high indicate a misadjusted or defective regulator or excessive circuit resistance in the system.

DETAIL TESTS

VOLTAGE PUT INTO CIRCUIT



Make this test to determine if the proper voltage is supplied to a component or circuit or if circuit resistance in wires, connections or switches are lowering the voltage below the normal operating range.

Example: Voltage at coil during cranking.

1. Set the VOLT & OHM Selector to 16V.
2. Connect the Black Voltmeter lead to ground, the Red lead to the battery terminal of the coil.
3. Ground out the coil's high tension lead. If the vehicle has a non-standard ignition system, refer to the manufacturer's procedure.
4. Crank engine, record voltmeter reading.

GOOD Voltage at coil within 1/2V (.5V) of voltage at battery during cranking.

BAD Low voltages indicate excessive circuit resistance in the leads, switches or connections between the coil and battery.

Other examples of Voltage put into a circuit are: voltage supplied to headlight circuits, and voltage supplied to the heater motor circuit.

CIRCUIT RESISTANCE IN AN INSULATED CIRCUIT

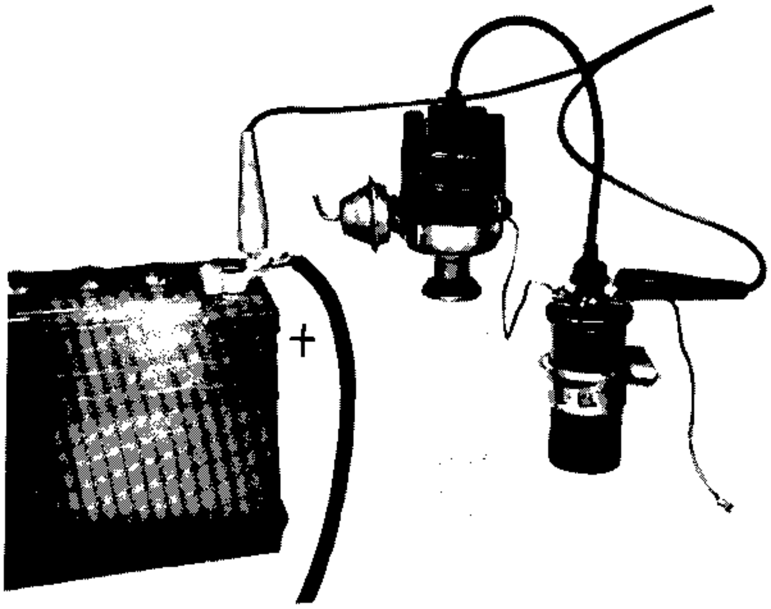
Make this test to locate the point of circuit resistance in an insulated (hot) circuit.

Example: (circuit resistance in ignition bypass circuit).

1. Set the VOLT & OHM Selector to 4V.
2. Connect the RED voltmeter lead to the + terminal of the battery, the BLACK lead to + terminal of the coil.
3. Ground out the coil's high tension lead. If the vehicle has a non-standard ignition system, refer to the manufacturer's procedure.
4. Crank the engine and record the voltmeter reading.

GOOD-Voltmeter reads less than .5V, or as specified by the manufacturer.

BAD Voltmeter reading of more than ½ V (.5V) indicates excessive circuit resistance. Pinpoint the location by moving the red lead to the next connection point in the circuit and reading voltmeter. When the reading drops the excessive circuit resistance was in the last wire, or connection. Maximum allowable circuit resistance is .3 Volt at any switch, .2 Volt in any lead, 0 at any connection.



CIRCUIT RESISTANCE IN A GROUND CIRCUIT

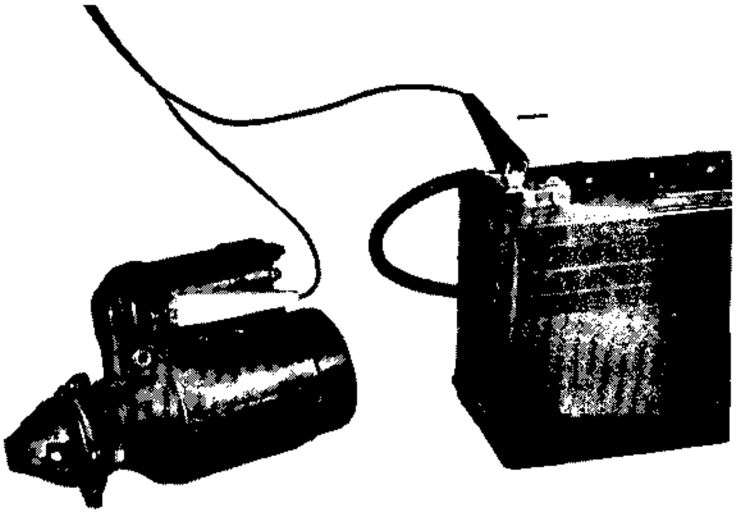
Make this test to locate the point of circuit resistance in a ground circuit.

Example: Circuit resistance in the starter ground circuit.

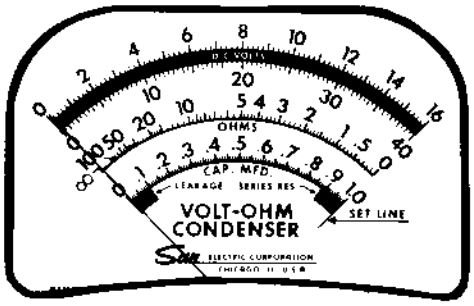
1. Set VOLT & OHM Selector to 4 V.
2. Connect the RED voltmeter lead to the starter motor housing, the BLACK lead to the - (or neg.) battery terminal.
3. Ground coil secondary wire. If the vehicle has a non-standard ignition system, refer to manufacturer's procedure.
4. Crank the engine and note the voltmeter.

GOOD Voltmeter reads less than .2V or as specified by manufacturer.

BAD Voltmeter reading of more than .2V indicates excessive circuit resistance. Pinpoint the location by moving the red lead to the transmission or engine, then to the battery ground cable, etc., and read the voltmeter. When the reading drops, the excessive circuit resistance was in the last connection or wire. Maximum allowable circuit resistance is .1 Volt in any lead, 0 at any connection.



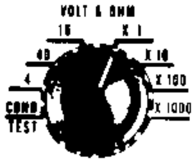
OHMMETER



The Ohmmeter measures the amount of electrical resistance in a circuit. It is primarily used in detail testing electrical components like coils, relays and spark plug wires.

Examples of typical resistance measurements are; resistance of primary and secondary windings of ignition coils, of ballast resistors and spark plug wires.

The Ohmmeter uses the black twin-flex cable. All measurements are made with the circuit open and with NO power applied.



The VOLT & OHM selector knob is used to select one of the four ranges of resistance to be measured. The Ohmmeter scale is read from right to left (opposite to the normal direction).
In the X1 position, read the scale directly.
In the X10 position, read the scale and add one zero to the reading.
Example -- 4 becomes 40.
In the X100 position, read the scale and add two zeros to the reading.
Example -- 4 becomes 400.
In the X1000 position, read the scale and add three zeros to the reading.
Example -- 4 becomes 4000.

Always calibrate the ohmmeter after selecting the range by connecting the test leads together and turning the COND. OHM-COIL CALIBRATOR knob until the meter reads on the Set Line.

DETAIL TESTS

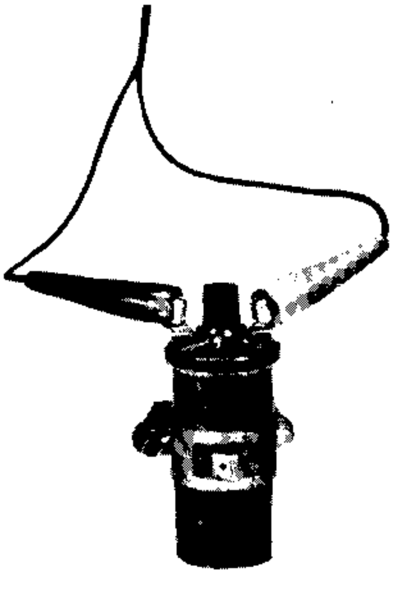
IGNITION COIL PRIMARY RESISTANCE

Make this test to measure the resistance of the primary windings of an ignition coil to determine if it is the correct value.

1. Set VOLT & OHM selector to X1.
2. Calibrate meter.
3. Disconnect the ignition leads from the coil.
4. Connect either test lead to the + terminal of the coil, the other lead to the - terminal.
5. Read the meter.

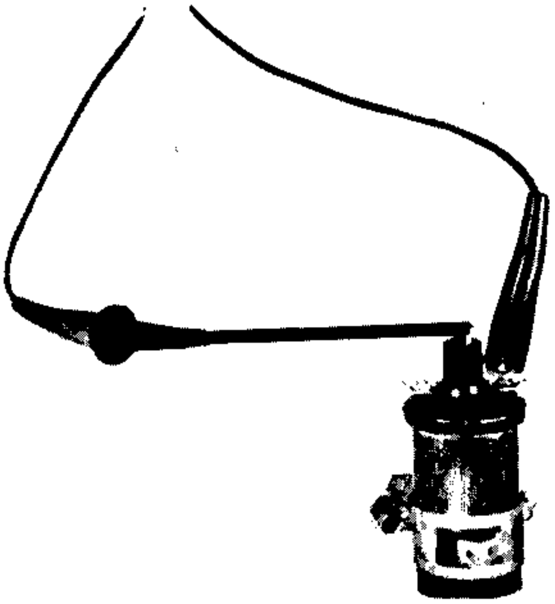
   GOOD Resistance is within specification when coil is at room temperature (has not been operated).

   BAD Resistance that is higher or lower than specified indicates an incorrect or damaged coil and that will affect ignition system performance.



IGNITION COIL SECONDARY RESISTANCE

Make this test to measure the resistance of the secondary winding of an ignition coil to determine if it is the correct value.



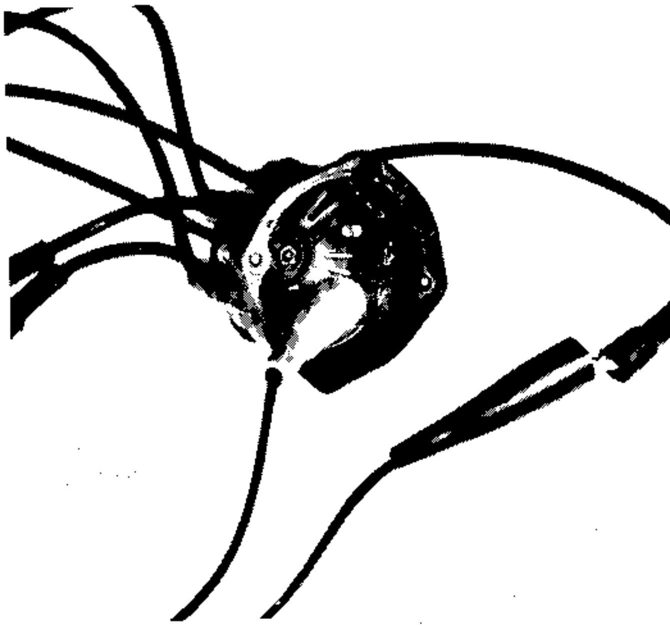
1. Set VOLT & OHM selector to X1000.
2. Connect either lead to the grounding probe
3. Calibrate meter.
4. Connect one lead to either primary terminal of the coil.
5. Connect the other lead to the center tower of the coil with grounding probe.
6. Read meter.

   GOOD Resistance is within specifications when coil is at room temperature (has not been operated).

   BAD Resistance that is higher or lower than specified indicates an incorrect or damaged coil that will affect ignition system performance.

SPARK PLUG WIRE

Make this test to determine if a spark plug wire has any breaks or opens, or if it is a resistor type wire, that it has the correct resistance.



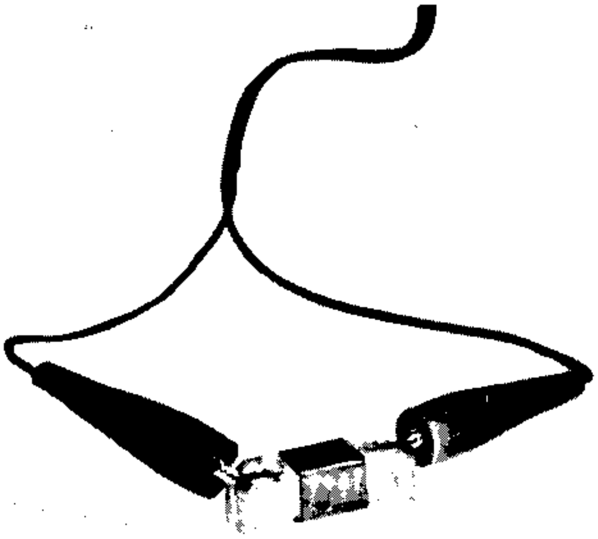
1. Set VOLT & OHM selector to X1000.
2. Calibrate meter.
3. Connect one lead to the spark plug end of wire.
4. Touch other lead to the insert inside the distributor cap.
5. Read meter.

   GOOD Resistance is within specification or if not specified, it is less than 20,000 Ohms.

   BAD Resistance that is not within specifications indicates a broken or otherwise damaged wire which will affect ignition system performance.

BALLAST RESISTANCE

Make this test to determine if the ballast resistor in the ignition primary circuit has the correct resistance.



1. Set VOLT-OHM Selector to X1
2. Calibrate meter
3. Disconnect the leads from one or both ends of the ballast resistor .
4. Connect one test lead to either end of ballast resistor.
5. Connect the other test lead to other end of ballast resistor.
6. Read meter.

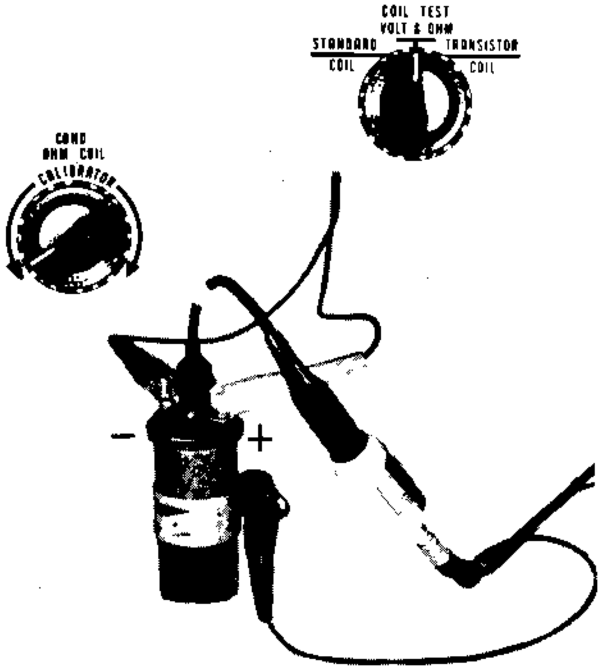
   GOOD Resistance is within specifications.

   BAD Higher or lower resistance than specified indicates the ballast resistor has the wrong value and will affect ignition system **performance.**

IGNITION COIL TESTER

The Ignition Coil Tester is used to test all types of ignition coils for shorts, opens, bad insulation and output. In addition, the tester may be used as a high voltage source to check out the insulation of components used in the secondary circuit.

The Ignition Coil Tester uses the black twin-flex leads to supply power to the coil. The COND.-OHM-COIL CALIBRATOR knob is used to adjust the voltage. The COIL TEST selector, the Sun Scope and its secondary pattern pickup leads are used to observe and measure the coil output.



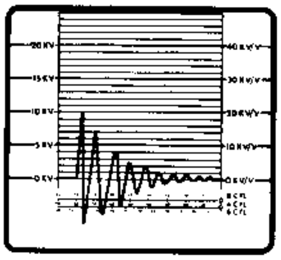
DETAIL TEST

Conventional or transistor coils.

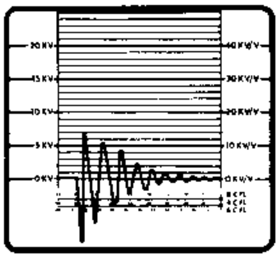
Make this test to determine if the ignition coil is the source of a problem indicated on the Scope.

1. Measure the primary and secondary coil winding resistance with the ohmmeter and compare to specifications. If GOOD, continue to step 2. If BAD, the coil should not be used for this application.
2. Connect the black twinflex leads to the primary coil terminals, RED to+, BLACK to-.
3. Clamp-on pattern pick-up: Insert the coil's high tension lead or a similar high tension type lead into the coil tower and clamp the pattern pick-up around the lead.
   Plug-in type pick-up: Put the pattern pick-up lead into the coil tower. Connect the black lead from the pattern pick-up to ground (coil holder or an engine ground if testing in the vehicle).
4. Follow the Sun Scope control setting procedure to obtain a display pattern of a secondary circuit. Set pattern height to 40KV.
5. Turn OHM-COND-CALIBRATOR knob full counter-clockwise.
6. Turn coil test selector to STANDARD COIL for conventional ignition systems or to TRANSISTOR COIL for transistor ignition systems.
7. Slowly turn CALIBRATOR clockwise until the highest part of the trace reaches 20 KV. Observe pattern.

GOOD

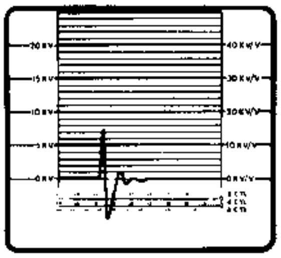


BAD



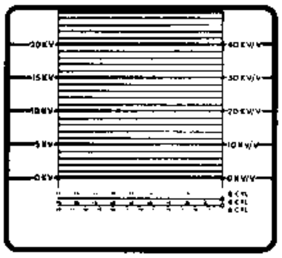
REVERSED POLARITY - First spike goes downward.

BAD



SHORTED - waveform does not reach 20 KV or has only a few oscillations, is jittery, or with a distorted shape.

BAD



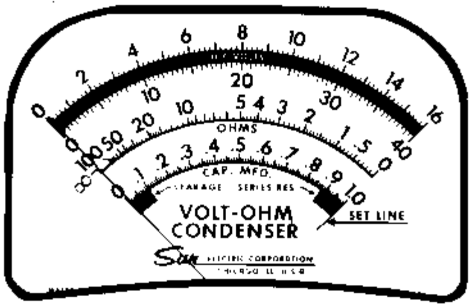
OPEN - Trace is a straight line.

MAGNETO COILS

Make this test to determine if the magneto's coil is the source of problems indicated on the Scope.

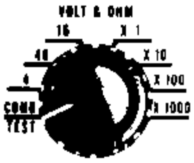
1. Magneto type coils are tested the same way as conventional coils except, do not exceed the manufacturers rated output or 20 KV, if not specified, during testing.

CONDENSER TESTER



The Condenser Tester is used to test the condensers used in various parts of an automobile's electric circuit. Condensers which may be tested include the ignition condenser found in the distributor and noise suppression condensers found on the generator, alternator or accessory motors.

Condensers are tested for three conditions. Series Resistance the amount of resistance in the pigtail lead and the ground circuit, Leakage the amount of current that can leak from one side of the condenser to the other and Capacity, the amount of energy in microfarads that the condenser can store.



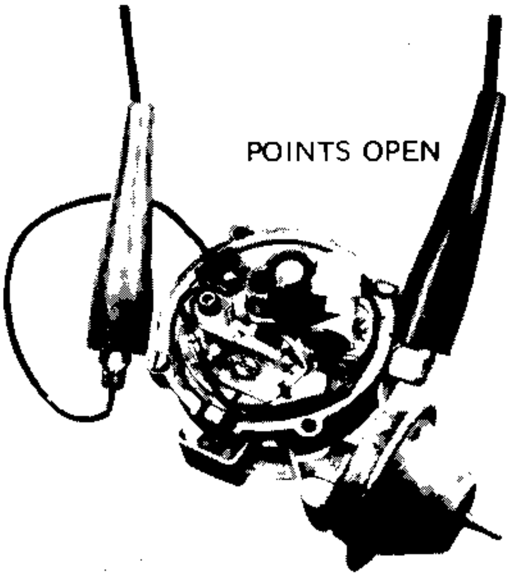
The condenser tester uses the twin-flex cable. The condenser to be tested should be electrically removed from the circuit by opening the ignition contact points or breaking the connection at the pigtail lead.

The VOLT & OHM selector knob is used to select the COND. TEST position.

To calibrate the tester connect the leads together and turn the COND. OHM-COIL CALIBRATOR knob until the meter reads on the SET LINE with the VOLT & OHM knob in the COND. TEST position.

IGNITION CONDENSER

Make this test to determine if the condenser is the cause of problems indicated on the scope in the maximum coil output test, in the intermediate section test or during point closing or opening tests. Also test to be sure a new condenser meets all operational requirements before installation in the distributor.



1. Disconnect the coil to distributor primary lead at the coil.

2. Bump engine over until contact points are open.

3. Connect one test lead to the end of the primary lead and the other to any good engine ground.

   NOTE: If condenser fails any one of these tests. STOP. Do not test any further. Replace the condenser.

4. Test for Series Resistance:

   a. The CONDENSER TEST knob is spring loaded in the SERIES RESISTANCE position.

b. The meter should read in the Black Band at the right end of the scale.

c. Move the pigtail leads. If moving the leads causes the meter to read out of the Black Band or move into the Black Band then the leads or ground circuit have excess resistance due to broken wires or poor connections. The distributor lead may be checked by moving the test lead to the end of the condenser pigtail lead and repeating this test.

d. To check if the excessive resistance is in the ground circuit, move the other test lead to the body of the condenser. If the meter now reads in the Black Band, then check for a poorly grounded condenser or distributor body.

5. Test for Leakage

   a. Move the **CONDENSER TEST** knob to LEAKAGE.

   b. The meter should now read in the Black Band at the left end of the scale.

   c. DO NOT TOUCH THE TEST LEADS OR CONDENSER PIGTAIL WHILE MAKING THIS TEST.

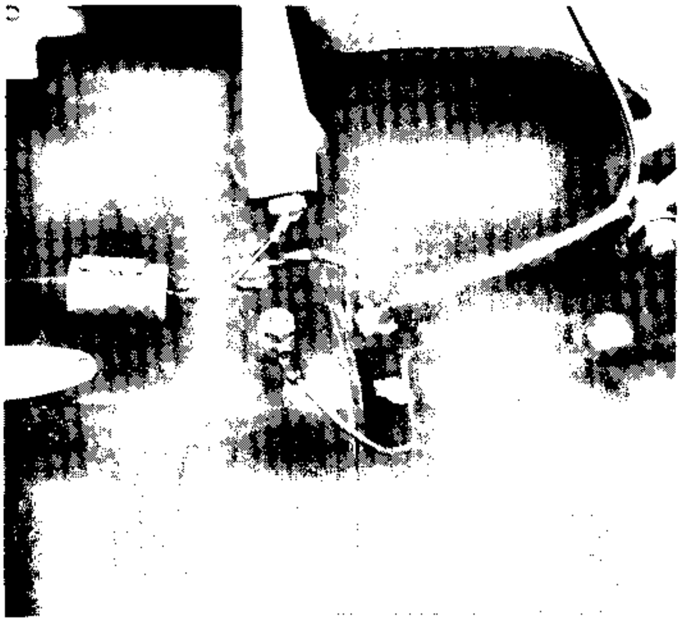
6. Capacity Test

   a. Move the **CONDENSER TEST** knob to CAPACITY.

   b. The meter will now read the capacity.

RESULTS GOOD--Condensers that test in the black bands for series resistance and leakage and within specification for capacity.

BAD--Condensers that test outside the black band for series resistance, or leakage, or the meter moves when pigtail lead is moved during the series resistance test, or are not within capacity specification should be replaced.



RADIO NOISE SUPPRESSION CONDENSERS

Make this test to determine if the Suppression Condenser is working properly if excessive radio noise is present in the radio or other electronic device.

1. Remove pigtail lead from terminal and test the same way as an ignition condenser.

Name: ____________________

ELECTRICAL COMPONENT TESTING QUIZ

1. Voltage is:

   A. Electrical flow
   B. Electrical pressure
   C. Electrical resistance
   D. Electrical capacity

2. Current is:

   A. Electrical flow
   B. Electrical pressure
   C. Electrical resistance
   D. Electrical capacity

3. An ohm is a measure of:

   A. Electrical flow
   B. Electrical pressure
   C. Electrical resistance
   D. Electrical capacity

4. Microfarad is a measure of:

   A. Electrical flow
   B. Electrical pressure
   C. Electrical resistance
   D. Electrical capacity

5. The ignition coil steps up voltage from 6 or 12 volts to as much as:

   A. 1,000 to 5,000
   B. 5,000 to 10,000
   C. 20,000 to 30,000
   D. 45,000 to 48,000

6. Which is part of the secondary ignition circuit:

   A. Condenser
   B. Breaker points
   C. Battery
   D. Distributor rotor

7. Which is part of the primary ignition circuit:

   A. Breaker points
   B. Distributor cap
   C. Distributor rotor
   D. Spark plugs

8. When using the ohmmeter, the item being checked:

   A. Should be electrically removed from the circuit
   B. Need not be removed from the circuit
   C. May be checked while the circuit is live
   D. No special precautions are necessary

9. Ignition coils and/or condensers may be tested either on or off of the engine.

   True False

10. During the coil output test, the wave-form on the scope indicates a good or bad coil.

    True False

REMOVING AND REINSTALLING DISTRIBUTOR

These are the basic steps necessary to remove a distributor from an engine for testing and to reinstall it when testing has been completed. There are also instructions that cover re-installation of a distributor when the engine was cranked over while the distributor was out of the engine.

REMOVAL

1. Remove the distributor cap.
2. Remove the vacuum advance hose or line.
3. Remove the coil to distributor wire at the coil.
4. Remove the distributor hold-down clamp and bolt.
5. Note position of rotor.
6. Pull distributor up and out of the engine noting the position of the rotor as the distributor clears the engine. The distributor is now ready to be tested.

RE-INSTALLING THE DISTRIBUTOR

Installation when the engine was not cranked while the distributor was out.

1. Put the rotor on the distributor shaft.
2. Position the rotor to where it was when the distributor was just removed from the engine.
3. Slide distributor down into the engine. Be sure rotor turns back to original position.
4. If the oil pump drive does not engage, check that rotor is pointing in correct direction.
    a. If it is not, pull the distributor out and repeat step 3.
    b. If it is, bump the engine over until the distributor drive drops into the oil pump drive.
5. Re-install the hold-down clamp and bolt finger tight.
6. Put the distributor cap on.
7. Reconnect the coil to distributor wire to the coil.
8. Reset the initial timing.

RE-INSTALLING THE DISTRIBUTOR
(ENGINE CRANKED OVER)

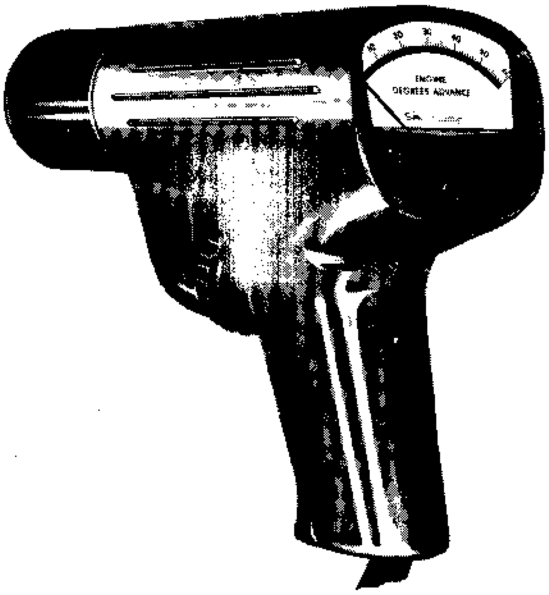
Follow these steps to install a distributor when the engine was cranked over while the distributor was removed.

1. Remove the spark plug from NO. 1 cylinder.
2. Screw in the proper cylinder leakage adapter hose into NO. 1 cylinder and put the whistle on the end of the hose.
3. Connect the remote starter switch to the starter solenoid.
4. Crank the engine until the whistle stops sounding. The timing marks should be at or near the indicator for TDC.
5. Put the rotor on the distributor shaft.
6. Determine from the specification card the location of NO. 1 tower on the distributor cap.
7. Position the rotor toward where the NO. 1 tower should be and push the distributor into the engine as far as it will go. Note how much the rotor has turned as the drive gear engages.
8. In order to have the rotor point exactly toward NO. 1, pull the distributor back until the drive gear is clear and turn the rotor backwards, far enough, so it will go directly toward NO. 1 when you push it back down.
9. Install the distributor. The rotor will now point to the NO. 1 tower.
10. Hold the distributor body and bump the engine over until the oil pump drive drops into place.
11. Reinstall the hold-down clamp and bolt finger tight.
12. Put the distributor cap on.
13. Reconnect the coil to distributor wire to the coil.
14. Reset the initial timing.

TIMING ADVANCE UNIT

The Timing Advance Unit is a power timing light with a built-in meter to measure the amount of advance or retardation of the spark due to action of the mechanical, vacuum advances or electronic control devices. This unit is used to test or set the initial timing and to quickly test the action of the advance/retard devices.

The Timing Advance Unit is used with the trigger pick-up lead connected to the timing cylinder.



AREA TESTS

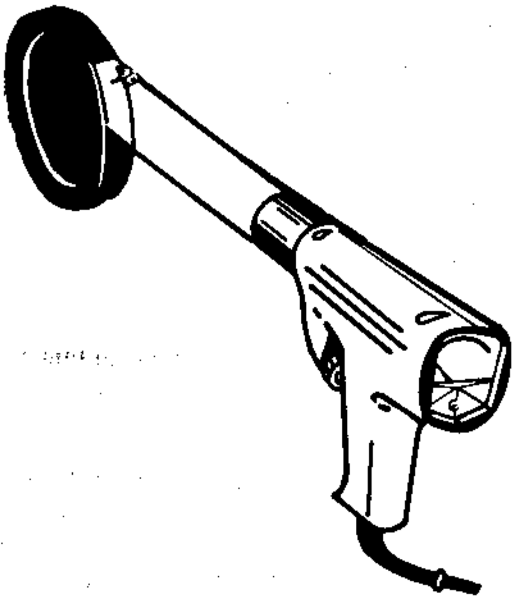
INITIAL TIMING

To test or set the initial or basic timing.

1. Connect trigger pick-up to the timing cylinder, usually NO. 1.
2. Place the cycle selector switch to the proper position, 4 CYCLE or 2 CYCLE.
3. Turn the ENGINE RPM knob to AUTO or 1000.
4. Start and warm up the engine.
5. Set the engine RPM to the speed specified for initial timing.
6. Remove or disconnect vacuum hoses if specified. Plug vacuum source to prevent RPM change.
7. Turn TIME/ADVANCE knob on the unit to the TIME position.
8. Aim Timing Advance unit at timing marks and press button. Note position of Timing Marks.

   GOOD Initial Timing within 1° of specification.

   BAD Timing marks not within 1° of specification.
9. Replace vacuum line(s) if removed.



TIMING ADVANCE

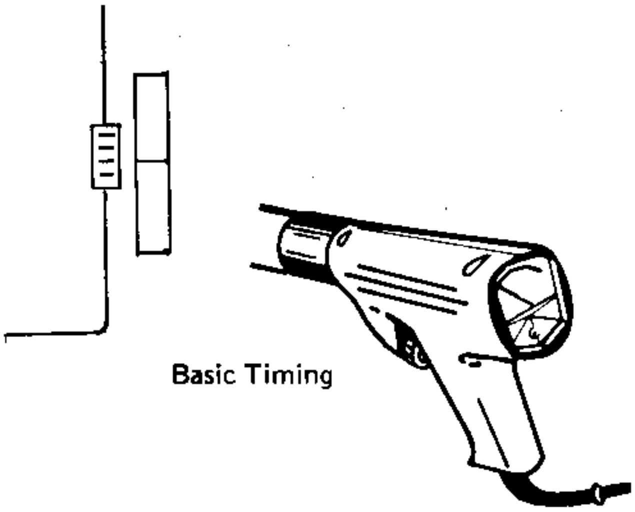
Make this test to determine quickly if mechanical and vacuum advance or electronic control devices are producing sufficient advance for proper operation.

1. Set ENGINE RPM knob to AUTO or 5000.
2. Set engine speed to 2500 RPM.
3. Aim Timing Advance unit at timing marks and press button.
4. Turn the TIME/ADVANCE knob until the timing mark moves back to the point where it was at idle (initial timing setting).

   Note reading on the meter on the back of the Timing Advance Unit.

   GOOD Advance readings within specifications for total advance.

   BAD Advance readings not within specifications indicate problems with either the mechanical or vacuum advance system. Use the timing advance unit to pinpoint the problem area.



Basic Timing

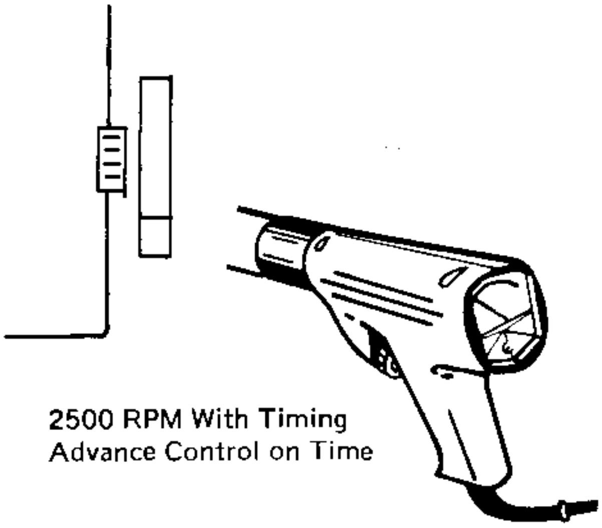
DETAIL TESTS

TIMING ADVANCE

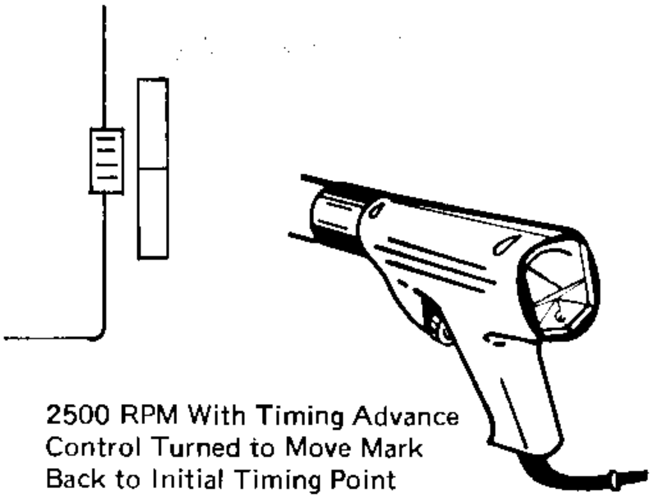
Make this test to pinpoint the lack of proper total advance to either a defective vacuum or mechanical (centrifugal) advance system. This test is done only when the total advance readings made above do not meet the specifications. During this test the vacuum advance is disconnected and the meter will read only the amount of advance caused by the action of the mechanical advance.

1. Disconnect vacuum advance line or hose from distributors vacuum advance mechanism.
2. Set the engine speed to 2500 RPM. Turn the TIME/ADVANCE knob until the timing mark moves back to the point where it was at the initial timing point.
3. Note advance reading.

   RESULTS: Meter should read within the specifications for Mech or Cent. (mechanical or centrifugal) advance. If it does, then the vacuum advance mechanism needs service. If the meter does not read within specifications for Mech or Cent advance system then the mechanical advance needs service.



2500 RPM With Timing Advance Control on Time



2500 RPM With Timing Advance Control Turned to Move Mark Back to Initial Timing Point

Name:______________________

DISTRIBUTOR TESTING QUIZ

1. Excessive drop in dwell as distributor speed is increased may indicate

    A. Point bounce
    B. Point float
    C. Poor condenser ground
    D. All of the above

2. The contact point resistance test using the dwell meter on the distributor machine will check the electrical condition of

    A. Ignition breaker points
    B. Pigtail lead
    C. Connections
    D. All of the above

3. The typical automotive distributor turns at

    A. One-half crankshaft speed
    B. Twice crankshaft speed
    C. Three times crankshaft speed
    D. Four times crankshaft speed

4. Extra arrows on the degree ring of the distributor tester indicate

    A. Point float
    B. Point bounce
    C. Both of the above
    D. Neither of the above

5. Distributor advance mechanisms that provide improper timing may cause

    A. Ineffective emission control
    B. Poor M. P. G.
    C. Possible high speed miss
    D. All of the above

6. A condenser should be tested for

    A. Series resistance
    B. Electrical capacity
    C. Electrical leakage
    D. All of the above

7. A distributor tester can be a real help when diagnosing gasoline mileage complaints.

   True False

8. Ignition breaker points can be made to give longer service if they are properly aligned when they are installed.

   True False

9. The chance of customer comebacks due to distributor problems may be reduced significantly and profits increased when distributors are removed from the engine and thoroughly cleaned, serviced and adjusted.

   True False

10. The distributor vacuum advance diaphragm is most easily checked for pinhole leaks by using the vacuum pump of the distributor machine.

   True False

SUN SCOPE

HOOK UP

The Sun scope uses only two cables to connect the scope to the engine's ignition system.

The cable is the Pattern pick-up and is connected to the primary ignition circuit at the coil's distributor terminal and to the secondary circuit at the coil's high tension tower. The trigger lead is used to trigger the scope so the pattern follows the firing order and is connected to the NO.1 Spark plug.

BASIC HOOK UP

Follow these steps to obtain a trace of both the secondary and primary ignition circuits on conventional ignition systems.

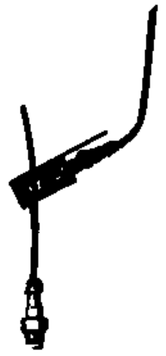
TESTERS WITH CLAMP-ON PICK-UPS

1. Clamp the Pattern Pick-up around the coil's high tension lead:
    a. For cranking tests, remove the coil high tension lead from the distributor center tower. Position lead so it does not touch ground or the case of Pattern Pick-up.
    b. For running tests, do not remove the coil high tension lead.
2. Connect the Red clip to the coil's distributor terminal.
3. Connect the Black clip to a good engine ground.
4. Clamp the Trigger Pick-up around the NO.1 spark plug lead near the distributor cap. If another cylinder is used for timing, clamp the lead around that cylinder's spark plug lead.

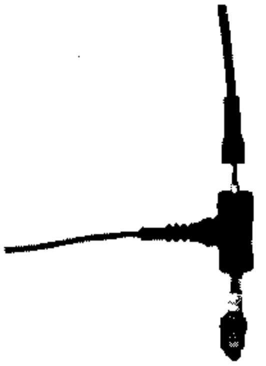
NOTE: If erratic tachometer operation and/or the scope mistriggers, check that the Trigger Pick-up Clamp surfaces are clean and firmly closed. If the problem persists, try the Trigger Pick-up on another cylinder. If the problem is corrected, then replace NO.1 spark plug lead, move Trigger Pick-up back and continue test.

TESTERS WITH PLUG-IN PICK-UPS

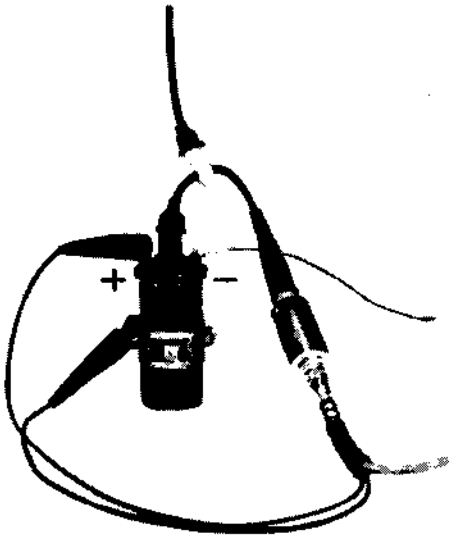
1. Remove the coil to distributor high tension lead from the coil tower.
2. Put the Pattern Pick-up Lead into the coil tower.
    a. For cranking tests, do not put the high tension lead into the pick-up adapter.
    b. For running tests, put the high tension lead into pick-up adapter.
3. Connect the Red clip lead to the coil's distributor terminal.



Trigger lead to:
Models SS-110, 400



Trigger lead for
Models SS-95, 87, 100



4. Connect the Black clip lead to an engine ground.
5. Connect the trigger lead to the spark plug circuit of NO. 1 cylinder, or the timing cylinder if other than NO. 1.

INTRODUCTION TO THE SUN SCOPE

The Sun Scope is a voltmeter. The line seen is voltage, represented on a TV like screen instead of a meter. The scope shows the voltage and how it changes during a period of time

The Sun Scope has the advantage of being able to show very rapid changes of voltage. Changes that occur so rapidly that a regular meter couldn't move, to show these voltage changes. An example of this type of rapid change occurs when a spark plug fires. The voltage changes from zero to 10,000 volts and back to zero in the time it takes the engine to turn enough to open and close the distributor points just once.

The shape of the line on the screen tells us what's happening in the ignition system. The scope shows the secondary ignition circuit at work. It shows how the coil, coil wire, distributor cap, rotor, plug wires, and the spark plugs work together as each cylinder of the engine fires. The shape of the line tells us how much voltage it takes to fire the plug, how resistance in the secondary circuit is affecting the arcing of the plug, how the coil and condenser are working and the condition of the contact points when they close and open to fire the next spark plug.

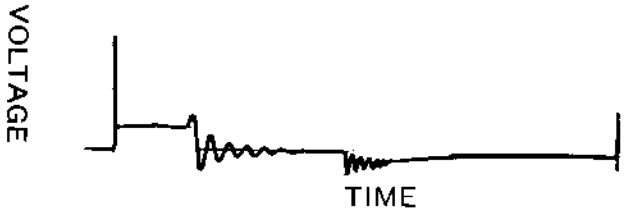


Figure 1

We'll look for the shape or pattern that is produced by a properly operating ignition system. Patterns that are different indicate problems in the ignition system. Problems in the primary ignition circuit, the contact points, condenser, coil and the connecting wires, affect the secondary ignition circuit pattern. A scope pattern that's different indicates a problem. The part of the trace that is affected indicates which components aren't working right.

Learning how to use the scope is then:

1. Learning what a good ignition system pattern looks like,
2. Knowing what components affect each area of the trace.

The secondary ignition pattern from a properly operating ignition system appears like Figure 1. This shows what's happening in just one cylinder of an engine.

The pattern may be divided into three parts (Figure 2): The firing section, the intermediate section and the dwell section. During scope testing we will look at each of these sections and compare them to a good pattern. The following information is an overview of the pattern we will be seeing.

The firing section consists of the firing line, the voltage required to fire the spark plug, and the spark line, the changes in voltage that occur as the plug arcs. At the end of the spark line the arcing at the plug stops.

The intermediate section which follows is a series of wavy lines (oscillations) that diminish in size. These lines show the coil and condenser using up the remaining energy left in the ignition circuit after the arcing has stopped.

When the ignition points close, to start the dwell section, the pattern goes down and is followed by oscillations which diminish in size. At the end of the dwell period the pattern turns sharply upwards.

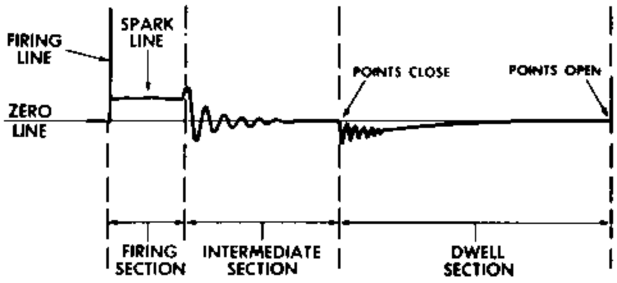
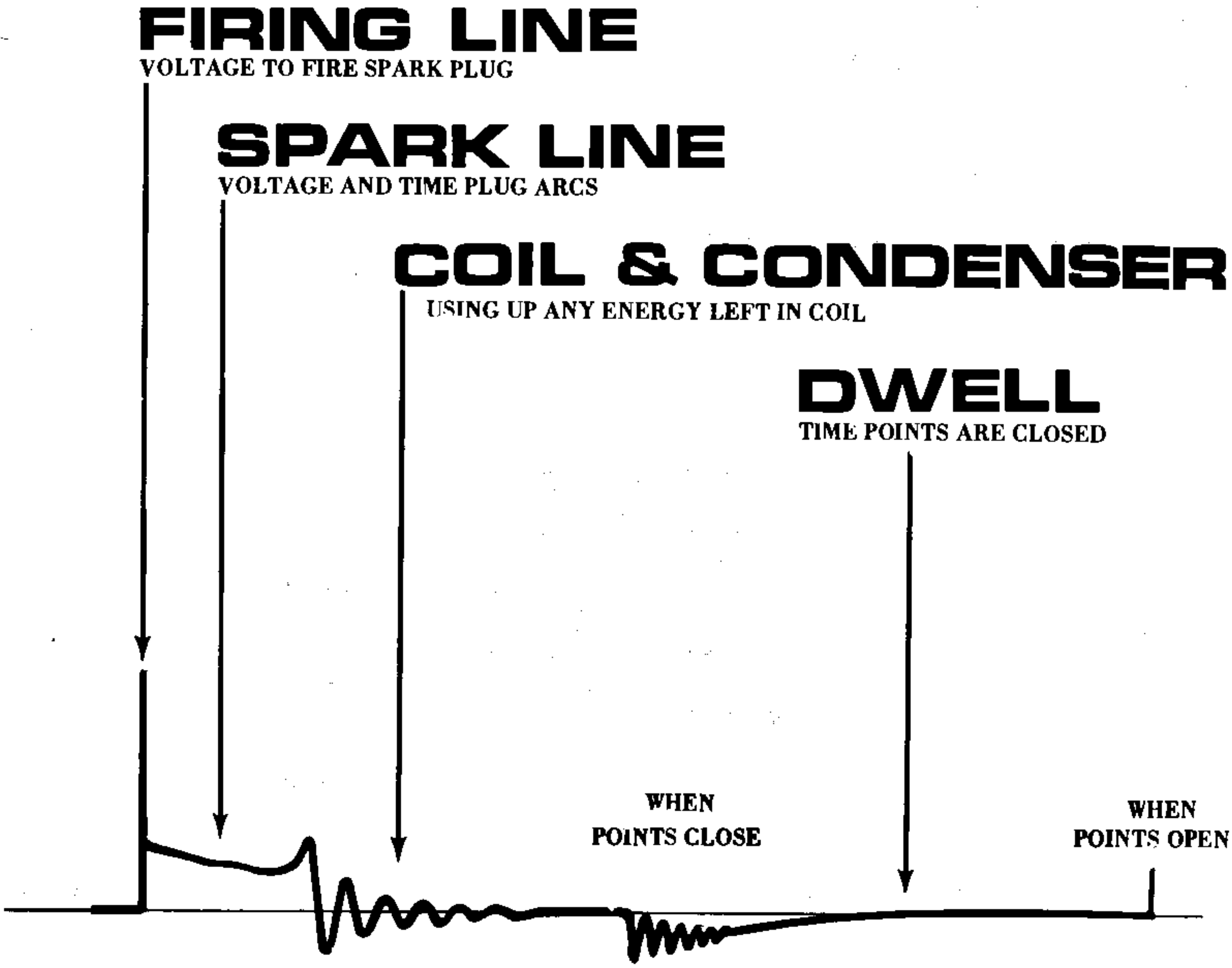


Figure 2

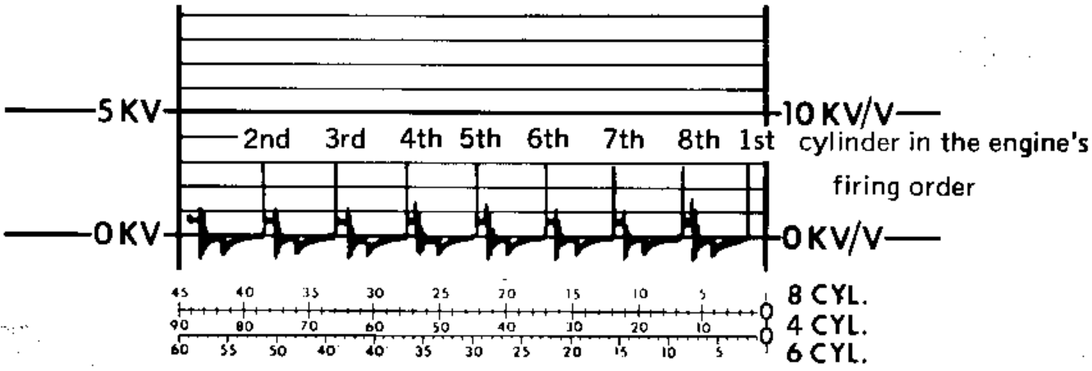
EVALUATION OF BAD TRACES

Problems with spark plugs, wires, rotor or engine conditions will be seen in the firing section. Coil, condenser, or primary circuit problems are found in the intermediate section. The dwell section will show up contact point or condenser problems.

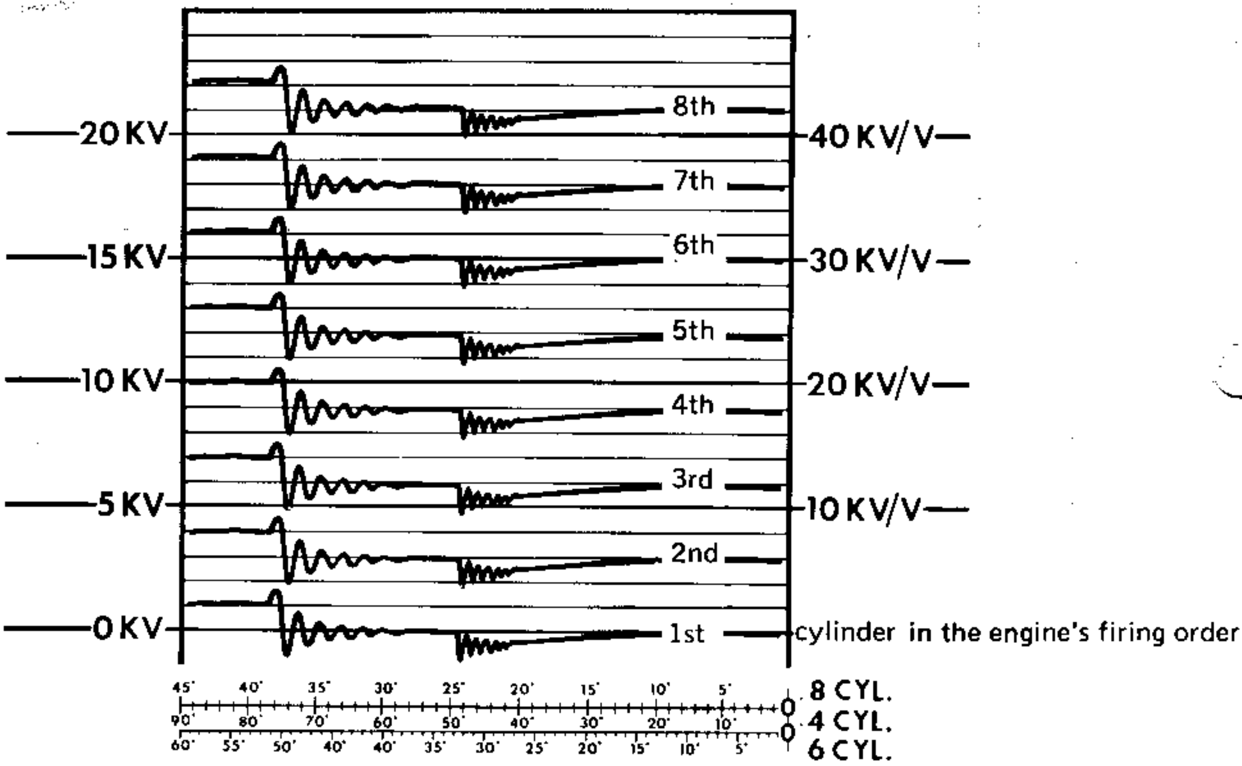


Problems here may be caused by:	Problems here may be caused by:	Problems here may be caused by:	Problems here may be caused by:
Plugs, wires, cap, rotor, or engine condition affecting plug firing.	Defects in coil condenser, or primary circuit.	Poor contact, dirty, burned or misaligned points and weak point tension.	Pitted points or arcing from poor condenser action.

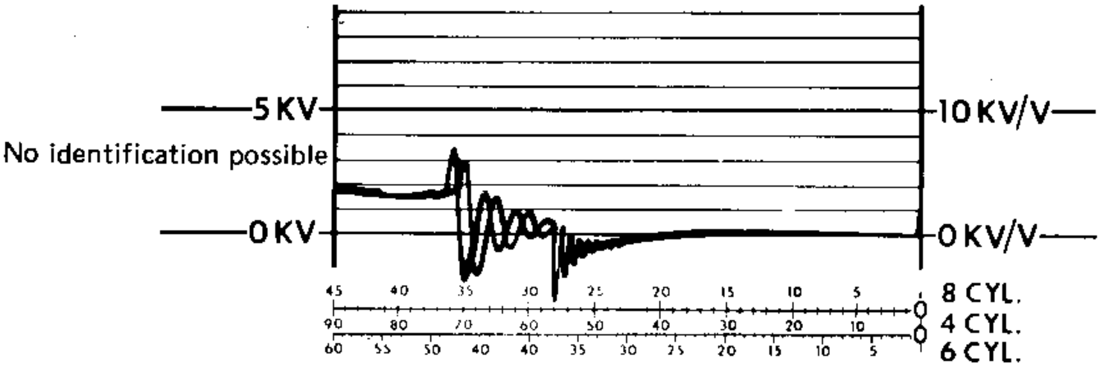
Method of identifing cylinders on Sun scope traces



DISPLAY



RASTER



SUPERIMPOSED

SUN SCOPE

SECONDARY IGNITION SYSTEM

TESTING

The scope measures the voltage in the secondary ignition circuit (spark plugs, plug wires, coil wire, cap, rotor). This voltage is then shown on the scope as a voltage and time picture. The scope shows the voltage required to fire the spark plugs, the effect of secondary circuit resistance on the arcing of the plugs, the action of the coil and condenser and the condition of the contact points as they close and open. In addition, the scope can be used to measure the maximum voltage the ignition system can develop, the insulation of the secondary circuit and the accuracy at which the ignition system fires each plug with respect to the mechanical operation of the engine. The scope also shows problems in the primary circuit that affect the secondary circuit.

Testing the secondary circuit requires the use of the high voltage pattern pickup and the black ground lead. Both are part of the Pattern Pick-up Cable. The trigger lead is connected to the NO. 1 cylinder spark plug lead.

The CIRCUIT SELECTOR is placed in SECONDARY. The PATTERN HEIGHT CONTROL should be placed in the 40 KV position and the PATTERN SELECTOR in DISPLAY.

CRANKING COIL OUTPUT

Make this test to determine if the ignition system can produce sufficient voltage to start the engine.

1. Remove the coil's high tension lead from the distributor center tower (clamp-on pick-ups) or from the adapter on the pattern pick-up (plug-in pick-ups). Do not allow the lead or the adapter to touch ground.

2. Crank the engine and record height of highest line on the scope's screen (40 KV scale).

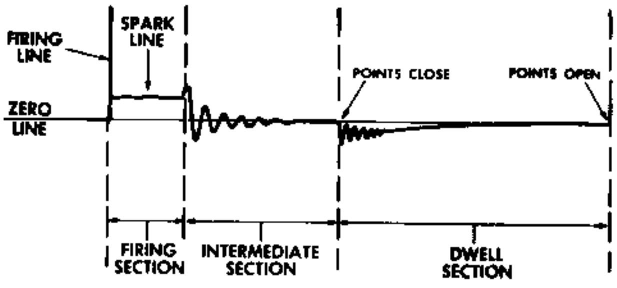
   GOOD Highest part of trace exceeds 20 KV.

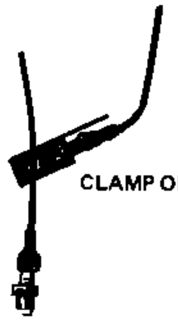
   BAD If the trace does not exceed 20 KV Check the dwell, the voltage applied to coil, check the coil with the coil tester and the condenser using the condenser tester.

2. Reconnect the coil high tension lead.

3. Start the engine and allow it to warm up.

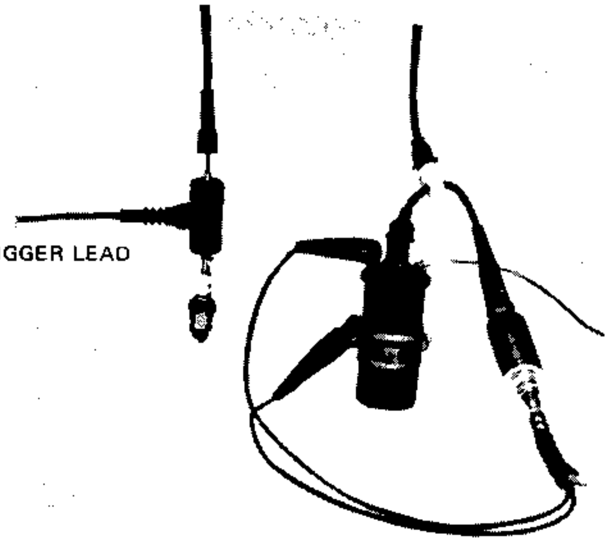
4. Set the engine speed to approximately 1000 rpm.

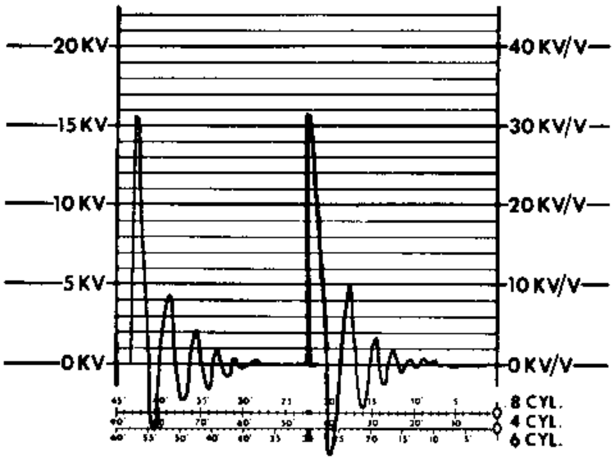




CLAMP ON TRIGGER LEAD

TRIGGER LEAD





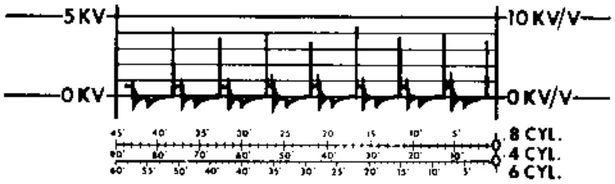
COIL POLARITY

Make this test to determine if the ignition system has the correct polarity.

5. Look at the firing lines.

   GOOD Firing lines go upwards.

   BAD If the pattern is upside down, check if primary leads are connected correctly or if the battery is installed wrong. The coil's polarity may be checked with the coil tester.



SPARK PLUG FIRING VOLTAGE

Make this test to determine if any problem exists in the spark plugs, plug wires, distributor, or in the engine, which affects the voltage required to fire the spark plugs.

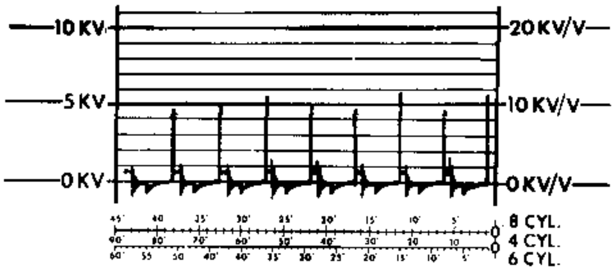
6. Record the height of the highest and lowest firing lines. Subtract the lowest from the highest.

   GOOD Maximum difference is less than 3 KV. No firing lines are above 15 KV or below 5 KV.

   BAD High firing voltages are usually due to excessive plug gap, lean fuel mixtures, broken or damaged spark plug wires, excessive rotor gap or poor connections in the secondary circuit. If all the firing voltages are high, look for problems in the coil wire, center distributor tower or rotor.

   Low firing voltages are usually due to fouled plugs or rich fuel mixtures.

   Uneven firing voltage, look for a cocked distributor cap or unbalanced fuel mixtures.



SPARK PLUGS UNDER LOAD

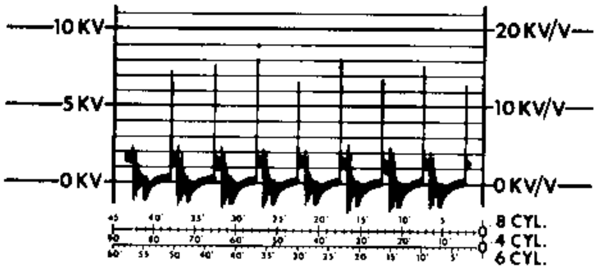
Make this test to determine the voltage necessary to fire the spark plugs when the engine is under load.

7. Return the engine to idle rpm.

8. Yank the throttle open briefly. Record the height of the highest and lowest firing lines. Subtract the lowest from the highest.

   GOOD Maximum difference between cylinders is less than 3 KV. The firing voltages of all cylinders increase slightly

   BAD If the firing voltage increases excessively, look for wide plug gap or poor spark plug electrode condition. If the firing voltages drop, look for plug fouling.

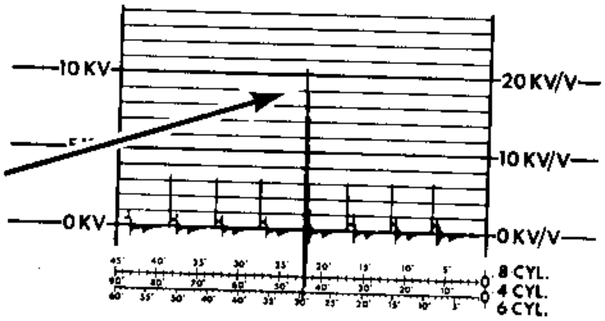


9. Return engine speed to approximately 1000 rpm.

AVAILABLE COIL VOLTAGE

Make this test to determine if the ignition system will produce enough to fire the spark plugs under all operating conditions.

10. Pull off any spark plug wire and hold it away from ground. Record height of trace for that cylinder.



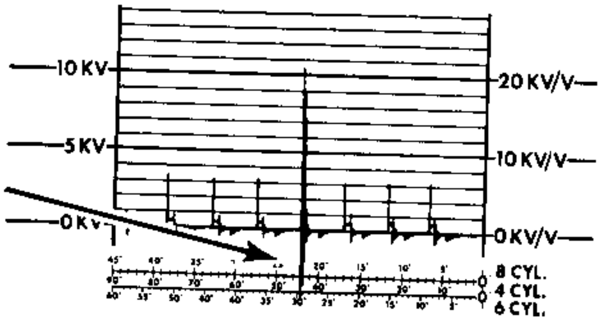
GOOD Highest part of trace exceeds 20 KV.

BAD If the output is low, check dwell; check for poor secondary circuit insulation; or check for excessive resistance in the primary circuit by measuring primary current with an ammeter. Check for a defective coil with the coil tester, for a defective condenser with the condenser tester.

SECONDARY CIRCUIT INSULATION

Make this test to determine if the insulation of the secondary circuit (cap, wires, plug or coil wire) will break down under operating conditions.

11. While holding the spark plug lead away from ground, note the first downward spike of the trace for that cylinder.



GOOD Downwards spike appears constantly

BAD No downward spike or an intermittent spike indicates an insulation breakdown in the secondary circuit.

12. Move the Pattern Selector to RASTER.

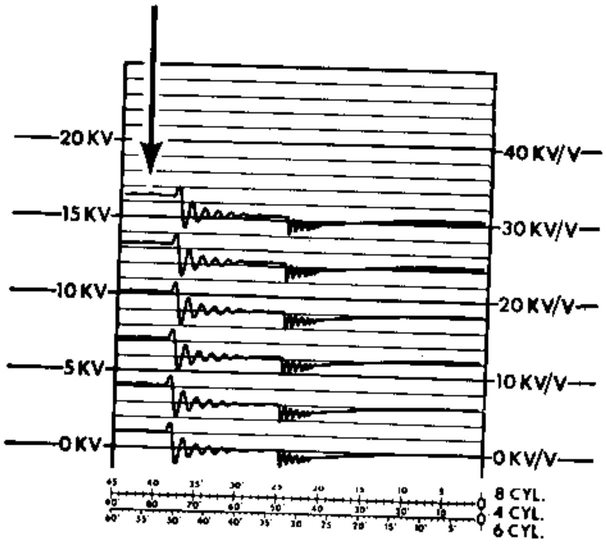
SECONDARY CIRCUIT CONDITION

Make this test to determine if there is excessive resistance in the secondary circuit.

13. Look at the spark lines of each cylinder.

GOOD Spark lines are nearly level and about the same length.

BAD Spark lines that slope excessively downwards indicates excessive secondary resistance in the spark plug, plug wires, distributor cap or rotor. Spark lines that are excessively long indicate a fouled plug or shorted secondary circuit.



If all cylinders are equally bad look for problem in the common components, rotor, center tower of the distributor cap, the coil wire, or coil tower.

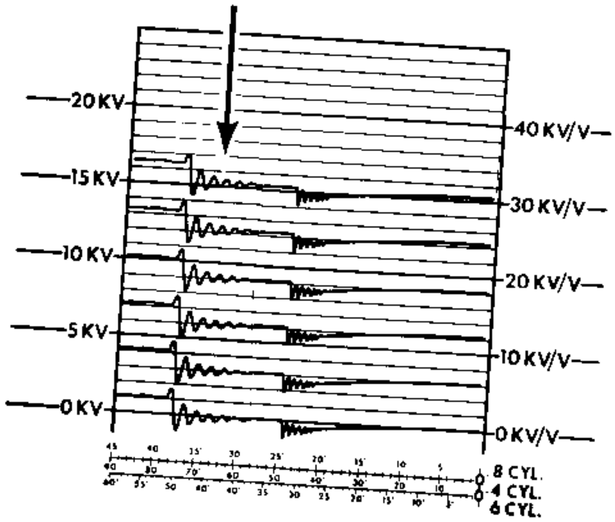
COIL AND CONDENSER CONDITION

Make this test to determine if the coil and condenser are working properly.

14. Look at the coil and condenser section.

    GOOD Several diminishing oscillations.

    BAD Only one oscillation or misformed oscillations indicate a coil or condenser problem. Test the coil with the coil tester and the condenser with the condenser tester.



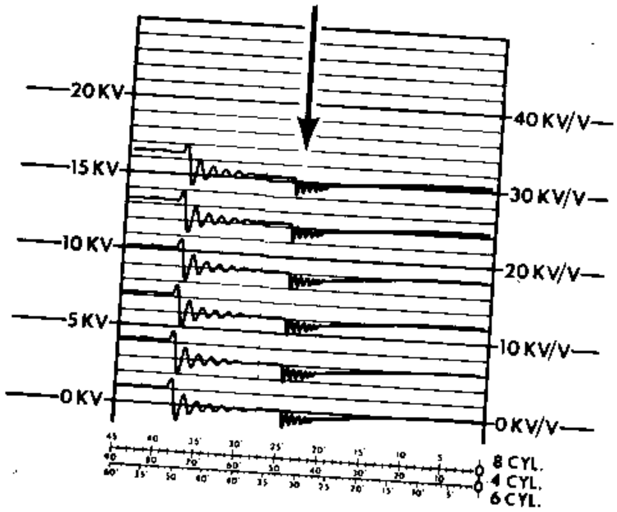
POINT CLOSE

Make this test to determine if the ignition contact points are closing properly without arcing due to dirty, misaligned or pitted points or bouncing due to incorrect point spring tension.

15. Look at the point close.

    GOOD A short downward line followed by diminishing oscillations

    BAD No oscillations or unusual upward spike that appears during the oscillations indicate point problems. Visually inspect the contact surface and test the point spring tension



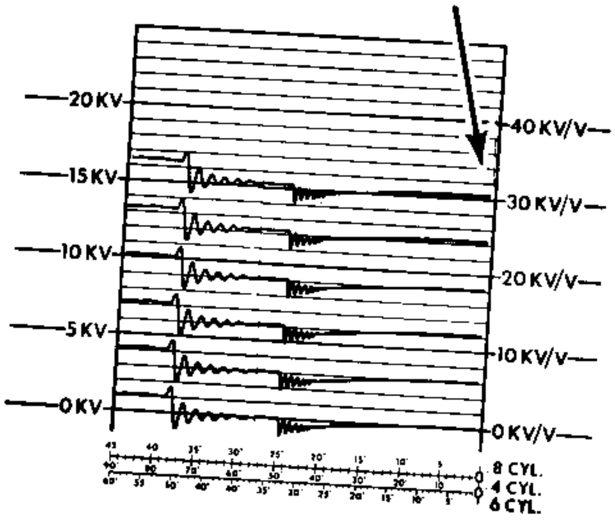
POINT OPEN

Make this test to determine if the ignition contact points are opening properly without arcing due to dirty, pitted surfaces or improper condenser action.

16. Look at the point open.

    GOOD Clean, sharp upward turning of the trace.

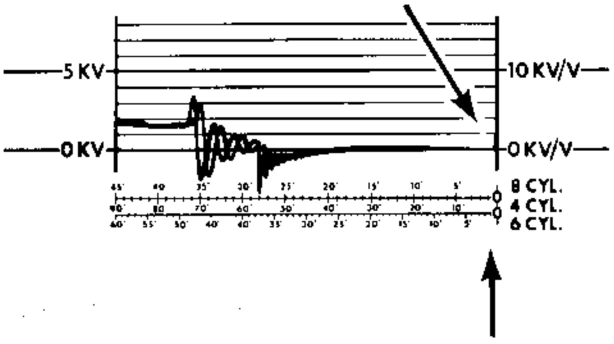
    BAD Hash or a step in the trace where it turns upward indicates the points are dirty or pitted or the condenser is not working properly. Visually inspect the points and test the condenser with the condenser tester.



17. Move the Pattern Selector to Superimposed.

CAM LOBE ACCURACY (Cylinder Timing Accuracy)

Make this test to determine if distributor cam lobe or distributor drive problems are affecting the time at which each cylinder fires.



18. Look at the point open.

GOOD Point openings within 2 degrees of each other.

BAD More than 2 degrees between point openings indicates distributor or distributor drive problems. Remove the distributor and test in a distributor testing machine.

Name ______________________

SCOPE TESTING WORKSHEET #1

	GOOD	BAD	GOOD	BAD	GOOD	BAD
1. CRANKING COIL OUTPUT (over 20 KV)	☐	☐	☐	☐	☐	☐
2. COIL POLARITY (pattern right side up)	☐	☐	☐	☐	☐	☐
3. SPARK PLUG FIRING VOLTAGE (maximum difference 3KV, firing lines between 5 and 15 KV high)	☐	☐	☐	☐	☐	☐
4. SPARK PLUGS UNDER LOAD (maximum difference between cylinders 3KV a slight increase in height on all cylinders)	☐	☐	☐	☐	☐	☐
5. AVAILABLE COIL VOLTAGE (over 20 KV)	☐	☐	☐	☐	☐	☐
6. SECONDARY INSULATION (downward spike)	☐	☐	☐	☐	☐	☐
7. SECONDARY CIRCUIT CONDITION (spark lines nearly level and about the same length)	☐	☐	☐	☐	☐	☐
8. COIL AND CONDENSER (several diminishing oscillations)	☐	☐	☐	☐	☐	☐
9. POINT ACTION						
a. POINT CLOSE (short downward line followed by diminishing oscillations)	☐	☐	☐	☐	☐	☐
b. POINT OPEN (sharp upward turn)	☐	☐	☐	☐	☐	☐
10. CAM LOBE ACCURACY (Cylinder timing accuracy) (2° maximum difference at point open and point close)	☐	☐	☐	☐	☐	☐

Name: ____________________

SCOPE QUIZ I

1. T F A vertical line on the scope screen represents voltage.

2. T F A horizontal line on the scope screen represents time.

3. T F A GOOD appearing scope pattern indicates a good ignition system.

4. T F Maximum coil output should be 10,000 volts.

5. T F The scope will show faulty point condition.

6. T F Spark lines that are level, do not start excessively high, and are free of oscillations are GOOD.

7. The scope provides a fast and accurate means of

   A. Diagnosing ignition system problems

   B. Quality control checking your work before it goes out the door to help eliminate "comebacks".

   C. Neither A or B

   D. Both A and B

8. Three basic sections of a scope pattern are:

   A. Firing, intermediate and raster

   B. Intermediate, dwell and coil and condenser

   C. Dwell, intermediate and firing

   D. Raster, superimposed and display

9. Good spark plug firing lines will

   A. Vary less than 3 KV and be 12-15 KV high

   B. Vary less than 3 KV and be 15-20 KV high

   C. Vary more than 3 KV and be 5-12 KV high

   D. Vary less than 3 KV and be 5-15 KV high

10. Identify the sections of this Raster pattern which show the condition of: (write correct letter in circle)

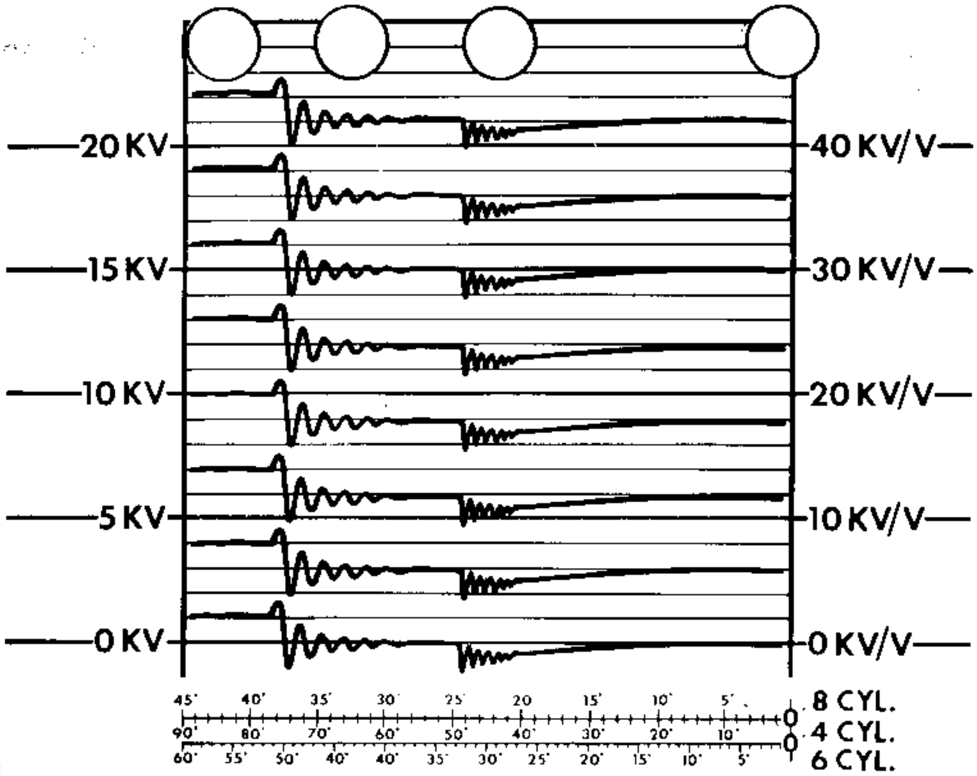
A. coil and condenser

B. points during closing

C. spark plugs and wires

D. points during opening

E. voltage required to fire spark plugs


20 KV
15 KV
10 KV
5 KV
0 KV
40 KV/V
30 KV/V
20 KV/V
10 KV/V
0 KV/V
45° 40° 35° 30° 25° 20 15° 10° 5° 0 8 CYL.
90° 80° 70° 60° 50° 40° 30° 20° 10° 0 4 CYL.
60° 55° 50° 40° 40° 35° 30° 25° 20° 15° 10° 5° 6 CYL.

Name ____________________

SCOPE TESTING WORKSHEET #2

Eng. No. ____________________ Make/Year ____________________

Cylinder No.								
Name of "BAD" part								
	GOOD	BAD	GOOD	BAD	GOOD	BAD	GOOD	BAD
1. CRANKING COIL OUTPUT	☐	☐	☐	☐	☐	☐	☐	☐
2. COIL POLARITY	☐	☐	☐	☐	☐	☐	☐	☐
3. SPARK PLUG FIRING VOLTAGE	☐	☐	☐	☐	☐	☐	☐	☐
4. SPARK PLUGS UNDER LOAD	☐	☐	☐	☐	☐	☐	☐	☐
5. AVAILABLE COIL VOLTAGE	☐	☐	☐	☐	☐	☐	☐	☐
6. SECONDARY INSULATION	☐	☐	☐	☐	☐	☐	☐	☐
7. SECONDARY CIRCUIT CONDITION	☐	☐	☐	☐	☐	☐	☐	☐
8. COIL AND CONDENSER	☐	☐	☐	☐	☐	☐	☐	☐
9. POINT ACTION								
a. POINT CLOSE	☐	☐	☐	☐	☐	☐	☐	☐
b. POINT OPEN	☐	☐	☐	☐	☐	☐	☐	☐
10. CAM LOBE ACCURACY (Cylinder timing accuracy)	☐	☐	☐	☐	☐	☐	☐	☐

GROUNDING PROBE

The grounding probe may be used to pinpoint problems in the secondary circuit. The probe is used to ground out sections of the secondary circuit starting at the spark plug. A problem seen on the scope will disappear when the component or components causing the problem are grounded out because the grounding probe offers an easier path to ground than the original circuit. These instructions show how to use this simple tool to pinpoint the cause of high firing voltage or high resistance.

PINPOINTING THE CAUSE OF HIGH FIRING VOLTAGES

Follow these steps to determine what component is the cause of a high firing voltage in one cylinder. If all firing voltages are equally high, check the rotor, distributor cap and coil wire for opens or breaks with the ohmmeter and by visual inspection.

1. Select, from the scope's DISPLAY pattern, a cylinder with a higher than normal firing voltage.

2. Stop the engine and place a spark plug adapter between the spark plug and the spark plug wire.

3. Restart the engine.

4. Connect one end of the 18" extension wire to the grounding probe and the other end to a good engine ground.

5. Touch the tip of the grounding probe to the spark plug adapter. This grounds out the spark plug. Look at the firing line on the scope.

   RESULTS-If the firing voltage drops to 5 to 7 KV, the cause of the high firing voltage is a wide gap or worn electrode on the spark plug or an engine condition such as a lean fuel mixture. If the firing voltage does not drop to 5 to 7 KV, then the problem is not spark plugs, engine condition or the fuel mixture. Continue to step 6.

   GROUNDING PROBE

6. Pull the spark plug wire out of the distributor cap using the insulated pliers and then stick the grounding probe down into the distributor tower. Be careful not to break or to damage the distributor tower.

RESULTS-If the firing voltage drops to 5 to 7 KV, the cause of the high firing voltage is the spark plug wire or a poor connection at the distributor tower.

If the firing voltage does not drop to 5 to 7 KV, the cause of the high firing voltage is in the distributor.

PIN POINTING THE CAUSE OF HIGH RESISTANCE

Follow these steps to determine what component is the cause of high resistance in one cylinder. High resistance is indicated when the spark line slopes sharply downward. If all the spark lines are equally bad; check the rotor, distributor cap and coil wire with an ohmmeter and by visual inspection.

1. Select the cylinder with a spark line that slopes sharply downwards.

2. Stop the engine and (a) place a spark plug adapter between the spark plug and the spark plug wire. (b) pull the boot back on the spark plug wire at the distributor cap tower.

3. Restart the engine.

4. Connect one end of the **18" extension wire** to the grounding probe and the other end to a good engine ground.

5. Touch the tip of the grounding probe to the spark plug adapter. This grounds out the spark plug. Look at the spark line on the scope.

   RESULTS If the spark line gets longer and levels out, the cause of the high resistance is the spark plug.
   If the spark line does not change or does not level out, then the problem is not in the spark plug. Continue to step 6.

6. Pull the spark plug wire out of the distributor cap using the insulated pliers and stick the grounding probe down into the distributor tower. Be careful not to break the wire's insulation or to damage the distributor tower.

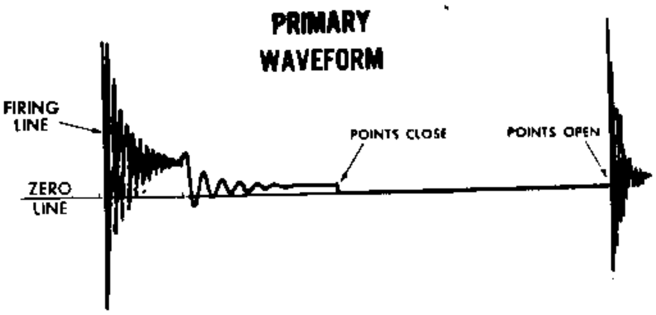
   RESULTS-If the spark line gets longer and levels out, the cause of the high resistance is the spark plug wire or a poor connection at the distributor tower.

   If the spark line does not change or does not level out, then the high resistance is in the distributor cap.

SUN SCOPE

PRIMARY CIRCUIT SYSTEM TESTING

The scope measures the voltage in the primary ignition circuit. This voltage is seen on the scope as a voltage and time picture. The scope shows the voltage in the primary circuit during the time the spark plug is firing, the action of the coil and condenser and the condition of the contact points as they close and open. It also shows the accuracy at which the ignition system fires each plug with respect to the mechanical operation of the engine.



Testing the primary circuit requires the use of the Red and Black leads, part of the Pattern Pick-up cable and the Trigger Pick-up.

The Circuit Selector is placed in PRIMARY + or -, depending on the vehicle's ground. The PRIMARY PATTERN HEIGHT CONTROL should be in the 400 V position.

DETAIL TESTS

FIRING SECTION

Make this test to determine if the primary circuit, the coil, condenser and the wiring are functioning properly while the spark plug is firing.

1. Set the scope control for DISPLAY.

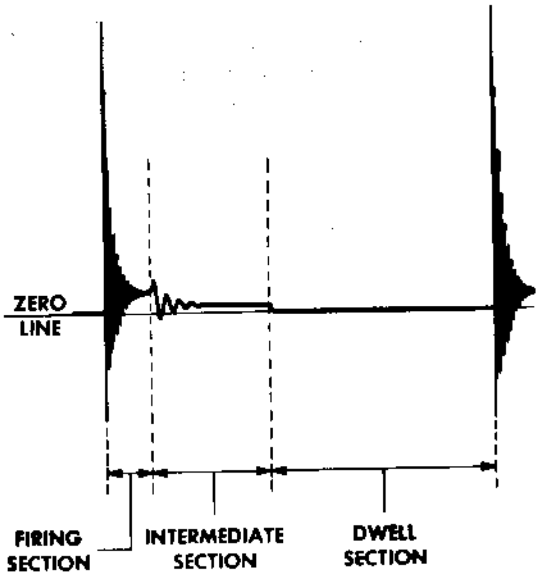
2. Start the engine and set the speed to approximately 1000 RPM.

3. Look at the firing section.

   GOOD Diminishing oscillations.

   BAD Distorted oscillations indicate problems in the secondary circuit such as: bad plugs or excessive secondary resistance.

4. Move the CIRCUIT SELECTOR to RASTER.



INTERMEDIATE SECTION

Make this test to determine if the coil and condenser are working properly.

5. Look at the intermediate section of the trace.

   GOOD Several diminishing oscillations.

   BAD Only one oscillation or misformed oscillations indicates problems in the coil, condenser or the primary circuit.

POINT CLOSE

Make this test to determine if the ignition contact points are closing properly.

6. Look at the point close.

   GOOD A short downward line followed by a level line.

   BAD Any upwards spike or hash on the trace after the downwards line indicates arcing due to dirty, misaligned or pitted points or that they are bouncing due to incorrect point spring tension.

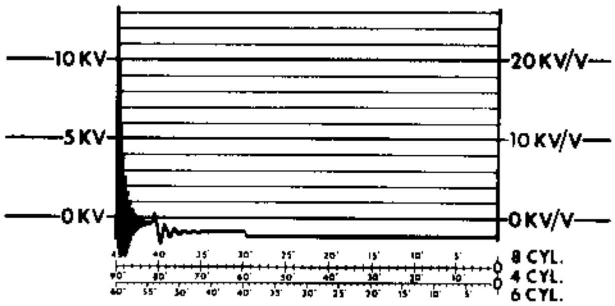
POINT OPEN

Make this test to determine if the ignition contact points are opening properly.

7. Look at point open.

   GOOD A sharp upwards turning of the trace.

   BAD Hash or a step in the trace where it turns upwards indicates arcing due to dirty, misaligned contacts, pitting on the contact surfaces or improper condenser action.



8. Move the PATTERN SELECTOR to SUPERIMPOSED

CAM LOBE ACCURACY (cylinder timing accuracy)

Make this test to determine if the distributor cam lobes or distributor drive problems are affecting the timing at which each cylinder fires.

9. Look at the point open.

   GOOD The point openings are within 2° of each other.

   BAD More than 2° between point openings indicate problems in the distributor or its drive. Test the distributor in a distributor tester.

SCOPE ALTERNATOR TESTING

The Sun scope may be used to check the electrical condition of an alternator's diodes or rectifier bank and its stator windings.

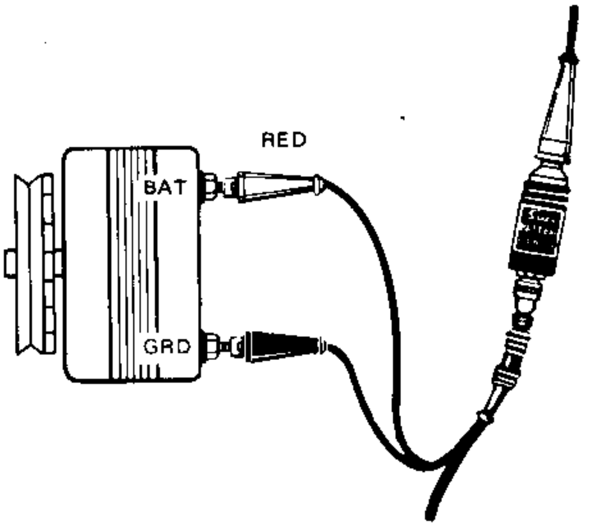
To make this test we use the scope, the Red and Black clip leads of the Pattern Pick-up and the Trigger Pick-up lead.

The Circuit Selector is placed in Primary + or -, depending on the vehicle's electric ground polarity and the PRIMARY PATTERN HEIGHT control is set to 40V.

ALTERNATOR TESTING

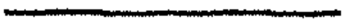
Make this test to determine if the diodes or the stator windings of an alternator are open or shorted.

1. Connect the Red clip lead of the pattern pick-up cable to either the alternator's output terminal or to the insulated battery terminal.
2. Connect the Black lead of the pattern pick-up cable to a good engine ground or the ground cable battery terminal.
3. Connect the trigger pick-up to the NO. 1 or timing cylinder.
4. Start the engine.
5. Apply a load to the charging system by turning on the headlights or heater blower.
6. Operate the engine at 1500 to 2000 RPM.
7. Look at the Trace. For improved clarity of the pattern, the pattern length may be turned full clockwise. Trace patterns and their meanings are illustrated at the right.

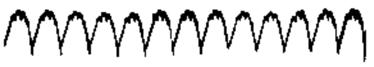


PRIMARY LEADS OF PATTERN PICK-UP

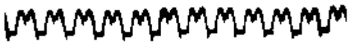
GOOD



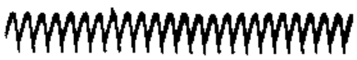
BAD



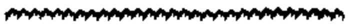
OPEN DIODE



SHORTED DIODE



OPEN STATOR



SHORTED STATOR

Name: ______________________

SUN SCOPE QUIZ II

1. The Sun Scope displays a graph-like picture of the ignition cycle showing

   A. Voltage and current
   B. Voltage and resistance
   C. Voltage and time

2. The amount of voltage required to maintain a spark across the gap of the spark plug is represented by the

   A. Firing line
   B. Spark line
   C. Intermediate oscillations

3. The opening of the ignition breaker points is shown at

   A. The end of the dwell section
   B. The beginning of the dwell section
   C. The end of the spark line

4. To perform an available coil voltage test

   A. Remove a spark plug wire and touch it to ground
   B. Remove a spark plug wire and hold it away from ground
   C. Accelerate the engine abruptly

5. What section of the scope pattern would indicate a faulty condenser?

   A. The firing section
   B. The intermediate section
   C. The dwell section

6. The Spark Plugs Under Load test is used to detect a faulty

   A. Ignition coil
   B. Condenser
   C. Spark plug

7. Primary and Secondary waveforms may be displayed on a Sun Scope.

   True False

8. Excessive secondary resistance will cause a spark line to appear greatly tilted.

   True False

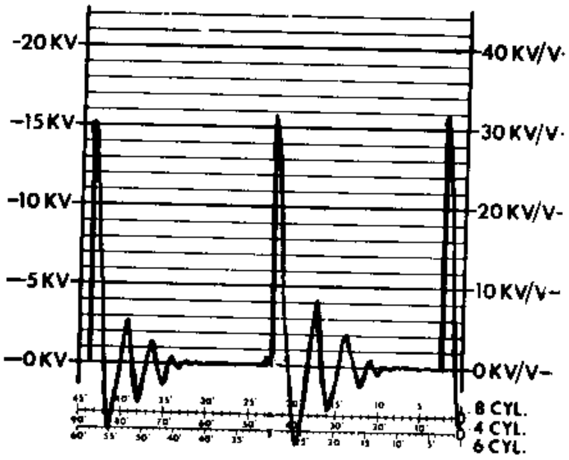
Evaluate the following test results with the scope set to the 40KV range.

GOOD BAD

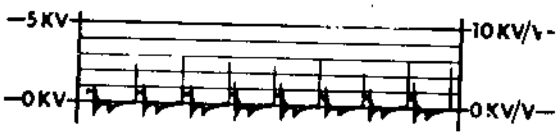
9. VISUAL INSPECTION

loose terminal on #2 wire,
oil soaked leads on the left bank ☐ ☐

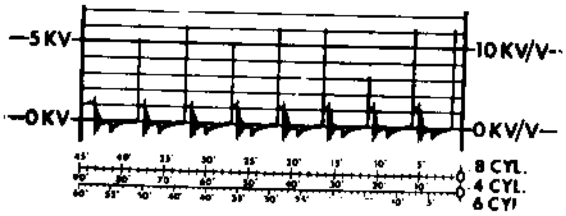
10. CRANKING COIL OUTPUT ☐ ☐



11. COIL POLARITY ☐ ☐



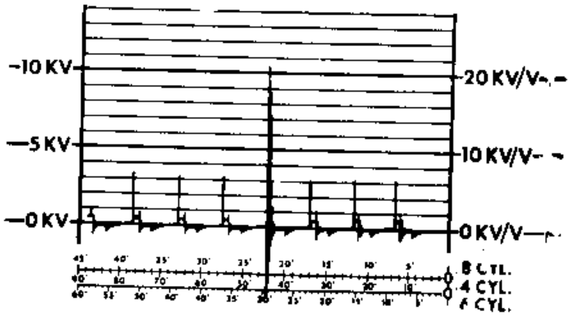
12. SPARK PLUG FIRING VOLTAGE ☐ ☐



13. MAXIMUM COIL OUTPUT AND SECONDARY INSULATION

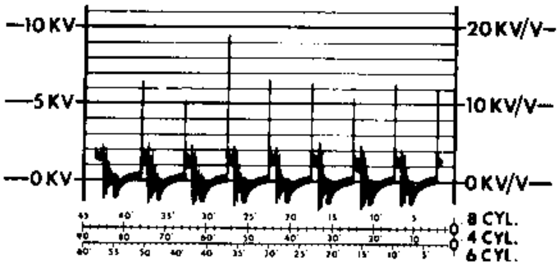
Maximum coil output ☐ ☐

Secondary insulation ☐ ☐



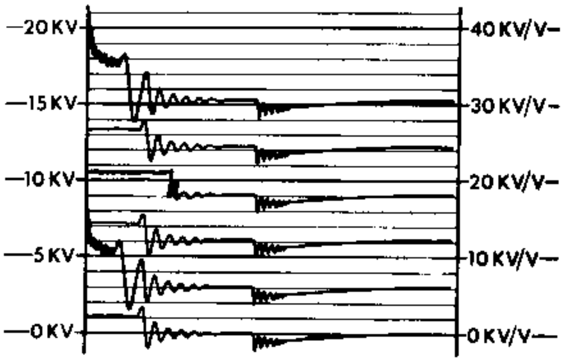
14. SPARK PLUGS UNDER LOAD

GOOD ☐ BAD ☐



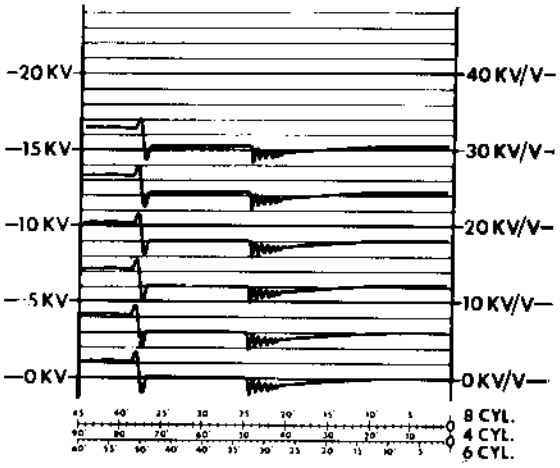
15. SECONDARY CIRCUIT CONDITION

GOOD ☐ BAD ☐

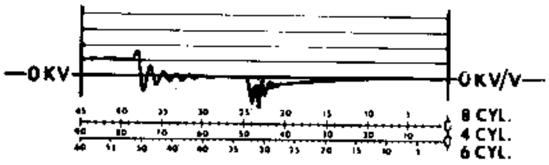


16. COIL AND CONDENSER CONDITION

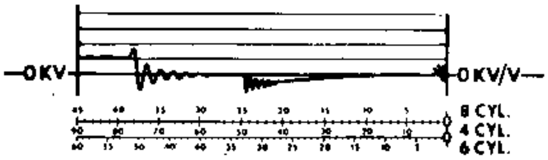
GOOD ☐ BAD ☐



17. BREAKER POINT CONDITION



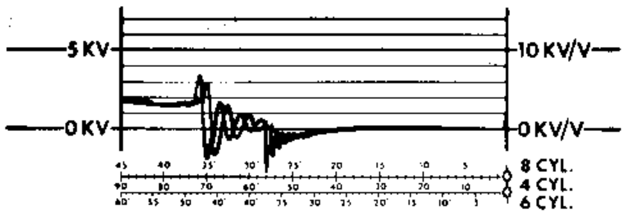
Points closing ☐ ☐



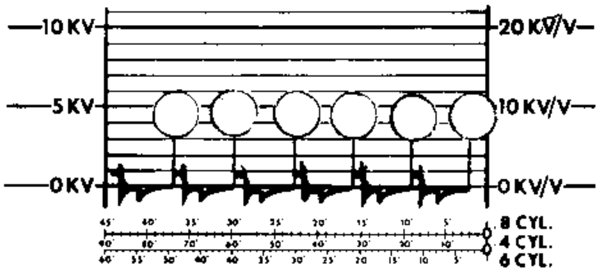
Points opening ☐ ☐

18. CAM LOBE ACCURACY

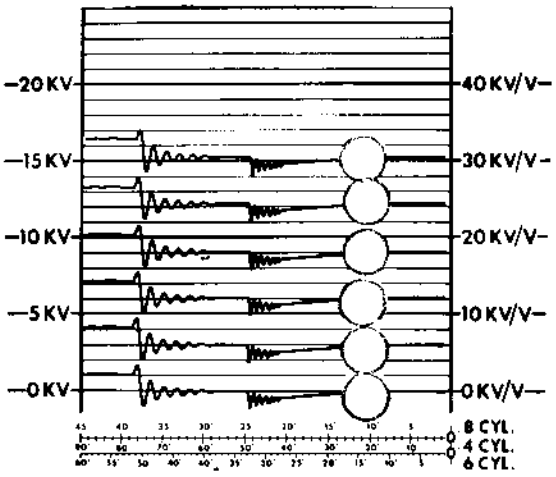
GOOD ☐ BAD ☐



19. Identify each cylinder for an engine with a 1-5-3-6-2-4 firing order.



20. Identify each cylinder for an engine with a 1-5-3-6-2-4 firing order.



FUEL PUMP TESTER

The Fuel Pump Tester is used to measure the pressure and volume of fuel delivered to the carburetor. It tests the effectiveness of the fuel pump, the ability of the fuel lines to carry the fuel from the tank to the pump, the venting system of the fuel tank and the ability of the carburetor's needle valve to shut off the flow of fuel in the float bowl.

The fuel pump tester uses a gauge assembly, a graduated fuel container and adapters to allow the tester to be used on various carburetors with both screw in fittings and slip on hose fittings.

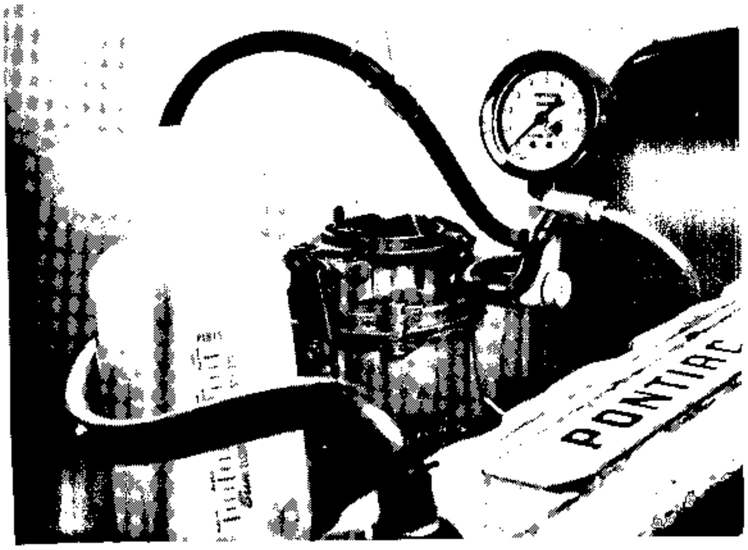
DETAIL TESTS

FUEL PUMP VOLUME

Make this test to determine if the fuel system can deliver the proper volume of fuel to the carburetor. This test should be done before pressure tests.

1. Remove the fuel line from the carburetor fitting.
2. Attach the FUEL PUMP TEST GAUGE to the carburetor's body. Use adapters as required. Tighten finger tight.
3. Connect the vehicles fuel line to the FUEL PUMP TESTER'S hose. Use adapters as required. Tighten finger tight.
4. Close the shut off clamp on the tester's VOLUME HOSE.
5. Start engine and run at specified test RPM for the Fuel Pump Volume Test.
6. Put the end of the Volume Hose down to the bottom of the graduated container and open the clamp.
7. Record the time to pump the specified amount into the container. Watch for air bubbles in the fuel.
8. Close the clamp.

See results after FUEL PUMP PRESSURE testing



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FUEL PUMP PRESSURE

Make this test to determine if the fuel system can deliver the fuel at the proper pressure to the carburetor. Always run the volume test before the pressure test to flex the fuel pump's diaphram so the pump will supply its full pressure during test.

1. Set engine to specified test RPM for fuel pump pressure test.
2. Record pressure on gauge.

Results of volume and pressure test.

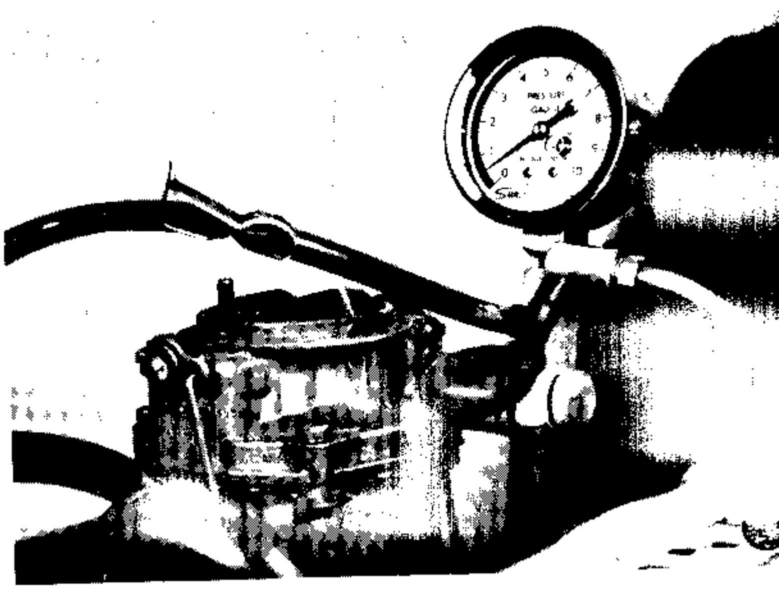
GOOD Volume and pressure within specifications .

BAD Volume and Pressure low indicates a defective pump or a restricted or leaking fuel line.

Volume good but Pressure is low indicates a defective pump (the pressure spring is weak).

Volume low but Pressure is good indicates a restricted or leaking fuel line or a defective pump (pump stroke too short, cam lobe or pump lever arm is worn).

Excessive bubbles in fuel indicates a leak in the fuel line between the pump and the fuel tank.



CARBURETOR NEEDLE AND SEAT/FUEL PUMP CHECK VALVE TEST

Make this test to determine if needle valve in carburetor or check valve in fuel pump are leaking when engine is not running.

1. Run fuel pump pressure test, note pressure.
2. Stop engine and watch pressure gauge for 30 seconds.

GOOD Fuel pump pressure remains within specifications.

BAD If the fuel pressure drops quickly toward zero this indicates problems in carburetor needle valve or fuel pump check valve.

Some vehicles with factory air conditioning may have a bypass fuel return line which will allow pressure to quickly drop to zero when the engine is stopped. These pumps may be identified by having an extra fuel line to return some of the fuel to the tank during operation.

FLOAT NEEDLE/FUEL PUMP CHECK VALVE TEST

Make this test to pinpoint the location of the loss of pressure between the fuel pump valves and the carburetor's needle and seat

1. Start engine and wait until pressure builds to specification.
2. Pinch off hose between vehicle fuel line and test gauge.
3. Stop engine and watch gauge for 30 seconds.

RESULTS If pressure now holds steady then the check valve in fuel pump is leaking.

If pressure drops quickly toward zero then the problem is the carburetor needle and seat.

Name ____________________

FUEL SYSTEM TESTING WORKSHEET

Eng. No. ______________ Make/Year ____________________

FUEL PUMP TESTING

GOOD BAD

Volume

(within specifications)

Spec ________ amount_____ Measured __________ ☐ ☐

Pressure

(within specifications)

Spec ________ PSI Measured __________ ☐ ☐

(holds pressure with engine stopped)

Measured __________ ☐ ☐

Vacuum

(within specifications)

Spec ________ inches Measured __________ ☐ ☐

EXHAUST EMISSION TESTER

The Infra-Red Exhaust Emission Tester is used to quickly indicate how well an engine is running. It also serves as a carburetor adjustment and testing tool, a PCV system tester and a leak tester.

The Infra-Red Tester measures the amount of Hydrocarbons (HC) and Carbon Monoxide (CO) in a sample of exhaust gas. Hydrocarbons are unburned gasoline and Carbon Monoxide is a gas produced during combustion. The HC meter reads parts-per-million (PPM) of Hydrocarbons and the CO meter reads percent (%) of Carbon Monoxide.

The level of Carbon Monoxide in the exhaust of a running engine is affected by engine timing and the air-fuel mixture.

The level of Hydrocarbons is affected by misfiring and compression losses. A misfiring cylinder dumps a charge of unburned gasoline (HC) into the exhaust and raises the HC reading.

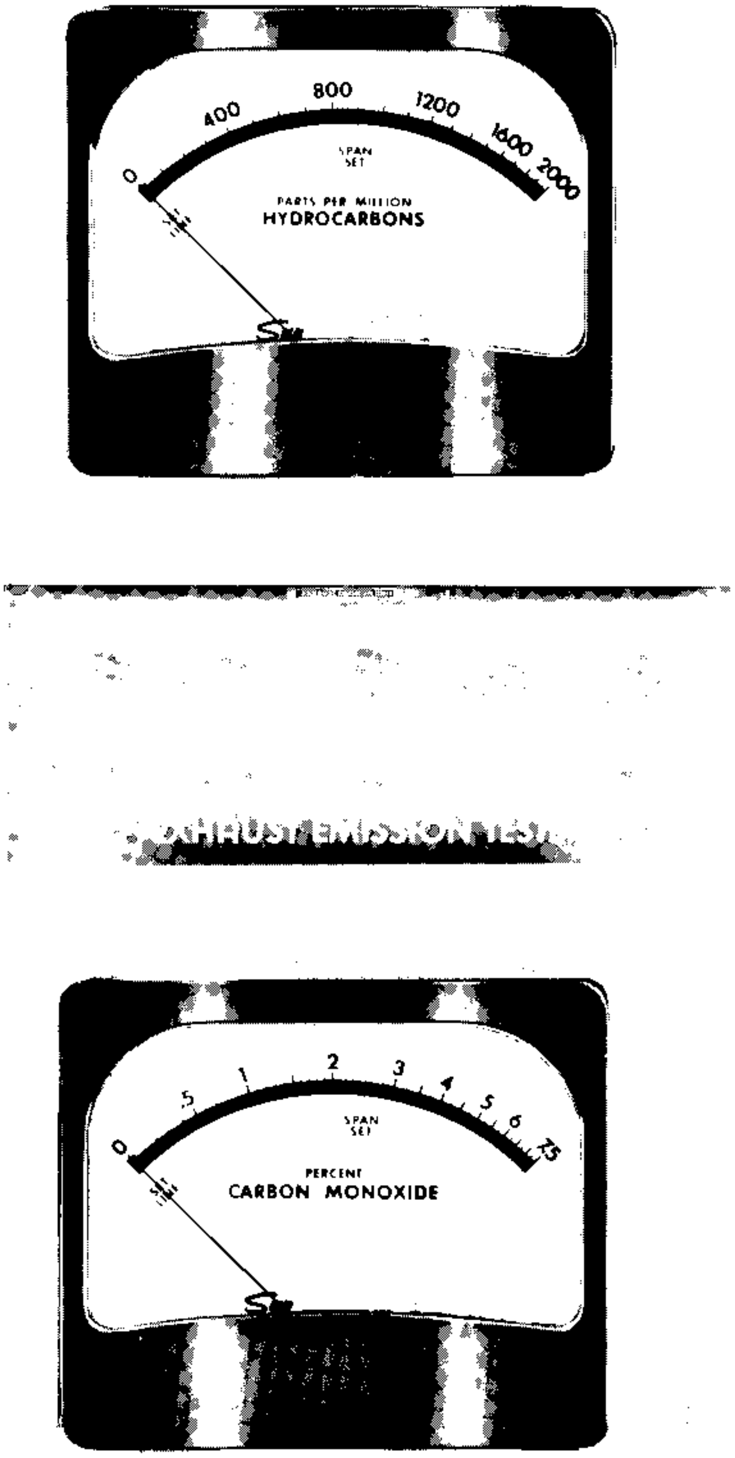
CALIBRATION

Follow this procedure to calibrate the CO and HC meters. Calibration may be checked at any time while using the tester. It is not necessary to remove the pick-up probe from the tail pipe during calibration.

Always check calibration of both the CO and HC meters after switching from OFF or STANDBY to TEST.

NOTE: Instructions in ( ) refer to testers with slightly different controls.

1. Turn OFF/STANDBY/TEST knob to TEST.
2. Set PULL TO CALIBRATE control to CALIBRATE (turn the two TEST/CALIBRATE controls to CALIBRATE).
3. Adjust the CO meter needle to SET LINE with the SET LINE ADJUST knob.
4. Hold SPAN switch up while adjusting the needle to the SPAN SET line with the SPAN SET knob (press and hold SPAN button).
5. Repeat the procedure for the HC meter and then push in calibration control (turn both TEST/CALIBRATE controls to TEST).



The instructions on this page are intended as an introduction to Infra-Red testing. They present the testing capabilities of the Sun Infra-Red Tester in detecting improper combustion or engine misfire and demonstrate how typical probelms cause increases in either CO or HC. Following these are practical in-shop tests using the Sun Infra-Red Tester.

INTRODUCTION TO MEASURING CO

1. Calibrate CO tester.
2. Connect tester to vehicle.
3. Warm engine to normal operating temperature.
4. Run engine at a fast idle (1500-2000 RPM) for 30 seconds to clear out excessive fuel from engine.
5. Run engine at specified idle RPM. Readjust to specified RPM, if necessary, using idle speed adjustment.
6. Read CO at idle.
7. Run engine at 2500 RPM. Read CO meter.

GOOD CO is within specifications at idle and equal or lower at 2500 RPM.

BAD CO is higher than specified at idle or increases at 2500 RPM. High CO is caused by problems which affect the fuel mixture or the burning of the fuel mixture.

EXAMPLES:

Improper idle speed.
Incorrectly adjusted idle mixture.
Internal problems in carburetor such as worn jets, dirt in jet or internal passages.
Incorrect float level.
Sticking or worn needle and seat.
High fuel pressure.
Sticking choke.
Improper timing.

CO SPECIFICATION FOR TUNE-UP TESTING
Emission controlled vehicles at idle RPM. CO less than 2.5%.
Non-emission controlled vehicles at idle RPM. CO less than 5%.

INTRODUCTION TO MEASURING HC

1. Calibrate the HC meter.
2. Connect the tester to the vehicle.
3. Warm engine to normal operating temperature.
4. Run engine at a fast idle (1500-2000 RPM) for 30 seconds to clear out excessive fuel from engine.
5. Run engine at idle RPM. Read HC.
6. Run engine at 2500 RPM. Read HC.

GOOD HC is within specifications at idle and equal or lower at 2500 RPM.

BAD HC is higher than specified at idle or increases at 2500 RPM.

HIGH HC is caused by misfiring in one or more cylinders due to compression, ignition or certain fuel system problems.

EXAMPLES:

Burnt or misadjusted valves.
Worn piston rings.
Blown out head gaskets or warped cylinder head.
Any other compression loss.
Fouled spark plugs.
High resistance spark plug or coil wires.
Poor connections in high tension circuit.
Spark plugs with cracked porcelain.
Carbon tracking in distributor cap or on rotor.
Excessively lean mixture(CO will be very low).

HC SPECIFICATION FOR TUNE-UP TESTING
Emission controlled vehicles at idle RPM--
HC less than 300 PPM.
Non-emission controlled vehicles at idle RPM-
HC less than 500 PPM.

SHOP TESTING WITH THE INFRA-RED

The following are practical in-shop tests using the Sun Infra-Red Tester.

CARBURETOR SETTING AND TESTING (IDLE)

The compression and ignition system must be working properly before starting carburetor adjustments.

1. Connect the sample hose to the vehicle's exhaust pipe.
2. Connect tachometer pick-up.
3. Check calibration of the tester.
4. Warm engine to normal operating temperature.
5. Run engine at a fast idle (1500 - 2000 RPM) for 30 seconds to clear out excessive fuel from engine.
6. Measure HC at idle.

GOOD HC is below specifications; or less than 300 PPM for emission controlled vehicles, or less than 500 PPM for non-emission controlled vehicles. Proceed to carburetor adjustment.

BAD HC is above specifications; the engine has a misfire due to ignition or compression problems not corrected during service. Before condemming, however, set the idle mixture to a slightly richer mixture to be sure problem is not over lean mixture misfire. If HC cannot be brought in to specifications, the misfire causing problem must be corrected before adjusting carburetor.

ADJUSTMENT PROCEDURE

7. Set idle mixture. Whenever they are available, follow the manufacturer's instructions for carburetor adjustment. If the manufacturer's instructions are not available this procedure may be followed:

   A. Back out the idle-mixture screws equally, from a lightly seated position, to get a rich mixture.

   B. Start the engine and set initial idle speed.

   C. Lean the mixture by turning the idle-mixture screws equal amounts. Hold idle RPM. Wait for the CO and HC readings to stabilize each time. (It takes about 7 seconds from the time you change something in the engine for the results to show up on the meters.)

8. Read CO and HC meters.

GOOD CO within specification indicates the fuel mixture is correct and no components are adversely affecting the burning process. HC did not increase and is within specifications; indicates that no misfiring is occurring due to undetected ignition or compression problems and mixture has not been set overly lean.

BAD CO cannot be brought into specifications, check for internal carburetor problems, sticking choke or improper timing. HC above specifications, check for ignition or compression problems. If HC went up during adjustment try enrichening mixture slightly. If the HC then goes down the mixture is too lean at idle. Check manufacturer's literature or service manuals for recommended changes to correct this lean misfire.

ACCELERATOR PUMP TEST

This procedure determines if the accelerator pump supplies sufficient additional fuel to prevent flat spots or stumble under both light and heavy acceleration.

9. Connect a vacuum gauge to a source of manifold vacuum.
10. Briefly open the throttle slightly to cause the vacuum to decrease about 2-3 inches (light acceleration). Read CO meter.
11. Open throttle briefly to obtain a large decrease in vacuum (hard acceleration). Read CO meter.

GOOD On both tests the CO meter does not initially indicate any leaner mixture (lower CO) and the CO increases at least 0.5% (light acceleration) and over 1% on hard acceleration.

BAD An initial decrease in CO, or a failure to show the specified increase indicates problems in the accelerator pump circuit. Check the accelerator's pump stroke, the linkage, plunger, check valves, etc.

CRUISE SPEED CARBURETOR TESTING

12. Run the engine at 2500 RPM. Read the CO and HC meter.

GOOD CO is equal to or lower than at idle. HC is equal to or lower than at idle.

BAD Higher CO indicates carburetor or fuel system problems.

Check float level, needle and seat, for dirt in carburetor jets or air bleeds, excessive fuel pressure, proper choke action, and proper timing advance.

High HC indicates ignition or compression problems.

High CO and HC indicate problems in ignition, compression or fuel system. Completely test the engine to determine which components require service.

NOTE: Some vehicles with fuel injection will not test accurately at 2500 RPM under no-load conditions. Testing of these vehicles at 2500 RPM should be done under load, such as on a chassis dynamometer.

PCV TESTING WITH THE CO METER

Follow this procedure to determine if the PCV system is functioning properly.

1. Remove the PCV valve from the engine but don't disconnect the hose that leads from it to either the carburetor or intake manifold.

2. Plug the open end of the valve. Read the CO meter.

GOOD CO increases.

BAD CO remains the same or increases only slightly. This indicates the PCV valve or the hose is plugged.

GO/NO-GO TESTING

This test is a way of inspecting a complete engine system quickly. An engine that fails to pass this test for CO, HC or idle speed needs further testing and service.

NOTE: The specifications given here are not tune-up or legal limits, but rather guide lines you may use to detect vehicles which require service. Be aware that some vehicles may pass these limits and still require service. In cases of customer complaints of engine performance we suggest you follow a Complete Engine Performance Test Procedure which includes an emission test.

1. Connect sample hose to vehicle's exhaust pipe.

2. Connect tachometer pick-up.

3. Check tester calibration.

4. Warm the engine to normal operating temperature.

5. Run the engine at a fast idle (1500-2000 RPM) for 30 seconds to clear out excessive fuel in the engine.

6. Record HC and CO at idle.

7. Record idle RPM.

8. Increase engine speed to 2500 RPM, record HC and CO.

GO HC and CO within specification (see below) at idle and both readings lower during 2500 RPM test. Idle speed within specifications.

NO/GO HC and/or CO are higher than specifications at idle or if either one increases at 2500 RPM, or idle not at specified RPM.

NOTE:
1. If HC is out of specification, the vehicle requires further testing to determine the cause of misfiring before service recommendations can be made.
2. If idle speed is incorrect, reset to specified RPM and repeat CO tests.
3. If idle speed is readjusted and CO is out of specification, readjust idle mixture. If CO cannot be brought into GO/NO-GO specifications, vehicle requires additional testing and/or service.
4. Some vehicles with fuel injection will not test accurately at 2500 RPM under no load conditions. Testing of these vehicles at 2500 RPM should be done under load, such as on a chassis dynamometer.

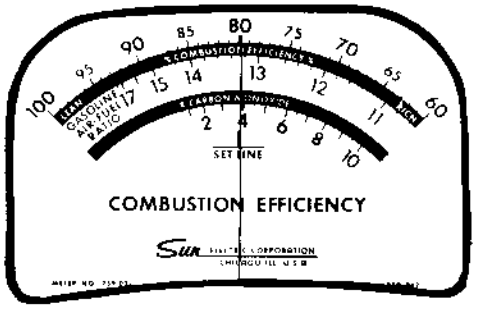
CO and HC SPECIFICATIONS FOR GO/NO-GO TESTING

Emission controlled vehicles @ idle RPM:

CO less than 3%	HC less than 400 PPM.

Non-emission controlled vehicles @ idle RPM:

CO less than 6%	HC less than 900 PPM.



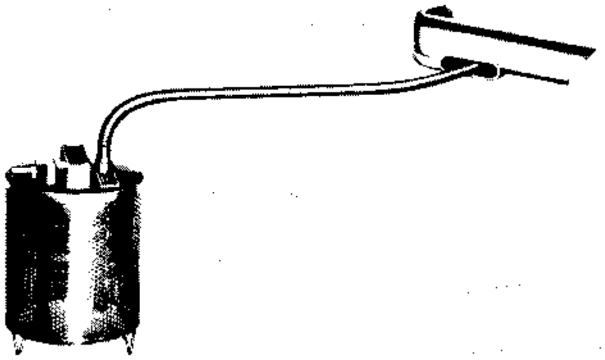
COMBUSTION EFFICIENCY METER

The Combustion Efficiency Meter is used to test how the fuel system of a vehicle is working. It is also used to test and adjust the idle mixture and to test the accelerator pump action.

The tester indicates the amount of Carbon Monoxide (CO) in a vehicle's exhaust. The meter also indicates the Air Fuel Ratio (AFR) for gasoline fueled engines and the percent of Combustion Efficiency.

The tester uses a metal pick-up hose to collect the sample gas, an exhaust gas condenser to remove excessive water vapor and a rubber hose to carry the gas sample up to the tester. The tester is controlled by a COMBUSTION CALIBRATOR control which also is the OFF/ON switch.

To calibrate the tester before using or at any time during use, remove the rubber hose from the exhaust condenser and move the end away from any exhaust. Turn CALIBRATOR CONTROL on, and adjust until the meter reads on SET LINE at the center of the scale. The unit is now calibrated. Reconnect the rubber hose to the exhaust condenser.



IDLE MIXTURE TEST

Follow these steps to check the idle mixture. The idle speed must be within specifications before making this test.

1. Connect trigger pickup to NO. 1 cylinder.
2. Turn the ENGINE CYCLE knob to the proper position.
3. Set the ENGINE RPM knob to AUTO or 1000 RPM.
4. Put the metal exhaust pickup hose into the tail pipe. On vehicles with dual exhaust, put the pickup in the side without the heat riser valve.
5. Read the combustion efficiency meter.

GOOD Meter reads within specifications (most 1968 and later vehicles) or if not specified:

1968 and later, with air pump type emission controls: Readings taken with the air pump's output disconnected from the air manifold. 3.5 to 4.5% CO (13.0 to 13.5 AFR, 78 to 82% combustion efficiency).

1968 and later, with emission controls other than air pump type: 1 to 2% CO (14.0 to 14.4 AFR, 85 to 87% combustion efficiency).

Pre-1968 with no emission controls: 5 to 6% CO (12.1 to 12.7 AFR, 72 to 76% combustion efficiency).

BAD A meter reading not within specifications indicates a need for readjustment or service to the carburetor.

IDLE MIXTURE SETTING

Follow the manufacturer's procedures for idle mixture adjustment. For a vehicle where no procedure is listed, the following may be used:

1. Before adjusting idle mixture, the idle speed, dwell, and initial timing must be within specifications. The compression and ignition systems, including the distributor, must also be functioning properly.
2. Connect Tachometer and Vacuum Gauge.
3. Set idle speed to specifications.
4. Adjust idle mixture screw for highest RPM and vacuum.
5. Reset idle speed to specification if necessary.
6. Put metal exhaust pickup hose into tail pipe and read combustion efficiency meter.

   RESULTS - See specifications under IDLE MIXTURE TEST

MIXTURE INTERMEDIATE RANGE

Make this test to check carburetor's intermediate operating range.

1. Set the ENGINE RPM knob to AUTO or 5000.
2. Increase the engine speed to approximately 1200 RPM and allow the meter to stabilize.

NOTE: On engines with air pumps:

1. Set idle speed with air pump connected and operational.
2. Disconnect the air pump, note change in idle speed. Maintain this speed while setting carburetor.
3. After completing all tests, reconnect air pump.

GOOD Idle RPM increases to specified RPM and CO reading decreases.

BAD Idle speed incorrect -reset to specification with idle speed screw.
CO does not decrease--check air pump and its contorls for proper operation.

3. Read combustion efficiency meter.

   GOOD Meter reads the same or lower % CO than at idle. (AFR and % Combustion Efficiency remain the same or increase.)

   BAD An increase in % CO indicates that the intermediate circuits of the carburetor require service. (AFR and % Combustion Efficiency decrease.)

MIXTURE - HIGH SPEED NO LOAD CONDITION

Make this test to check out the carburetors high speed operation under no load conditions:

1. Increase engine speed to 2500 RPM and allow meter to stabilize.

   Read combustion efficiency meter.

   GOOD Meter indicates a lower % CO reading than at idle or intermediate speeds. (AFR and % Combustion Efficiency increase.)

   BAD An increase in % CO indicates that the carburetor's high speed circuits require service. Check the float level, check for worn jets, plugged air bleeds or a malfunctioning power valve. (AFR and % Combustion Efficiency decrease.)

MIXTURE-HIGH SPEED UNDER LOAD

To check out the carburetor's high speed operation including operation of the power valve under load conditions during chassis dynamometer testing.

1. Increase engine speed to 2500 RPM under no load conditions. Read combustion efficiency meter.

2. Apply load to rear wheels and increase engine speed to 2500.

3. Read combustion efficiency meter.

   GOOD CO increases when load is applied to vehicle. A properly functioning power valve will cause the % CO to increase 2 to 3%. (AFR decreases 1.0, % Combustion Efficiency decreases 7%.)

   BAD Little or no increase or any decrease in % CO indicates problems in the power valve circuit. (AFR and % Combustion Efficiency readings indicate little or no decrease or any increase.)

ACCELERATOR PUMP

Make this test to determine if the carburetor's accelerator pump circuit supplies sufficient fuel for proper acceleration.

1. Allow engine to idle until combustion meter stabilizes.

2. Abruptly accelerate the engine and watch the combustion meter.

   GOOD % CO increases a minimum of 1%. (AFR decreases 0.5, % Combustion Efficiency decreases 7%.)

   BAD CO does not increase at least 1%, or shows any decrease. Indicates the accelerator pump requires service. (AFR decreases less than 0.5, % Combustion Efficiency decreases less than 7% or either show any increase.)

Name____________________

INFRA-RED TESTING WORKSHEET

INTRODUCTORY TESTS WITH THE SUN INFRA-RED TESTER

Note: Do each of these tests separately. Remove each "problem" after testing and allow the meter to return to the original reading before proceeding.

CO TESTS

	IDLE	2500RPM	GOOD	BAD
No changes	________ %CO	________ %CO	☐	☐
Change idle mixture (½ to 1 turn)	________ %CO	________ %CO	☐	☐
Change idle speed (50 to 100 RPM)	________ %CO	________ %CO	☐	☐
Plug the PCV system (pinch hose)	________ %CO	________ %CO	☐	☐
Sticking choke (hold closed)	________ %CO	________ %CO	☐	☐
Incorrect timing (change 10 to 15°)	________ %CO	________ %CO	☐	☐

HC TESTS

No changes	________PPM HC	________PPM HC	☐	☐
Fouled plug	________PPM HC	________PPM HC	☐	☐
High resistance plug wire	________PPM HC	________PPM HC	☐	☐
Very lean mixture (1 to 2 turns lean)	________PPM HC	________PPM HC	☐	☐

TYPICAL SHOP TESTS WITH THE SUN INFRA-RED TESTER

Carburetor setting and testing
(refer to instruction sheet for specifications)

HC at idle
(within specifications) ☐ ☐
Measured ______PPM
if GOOD, continue to adjustment procedure
If BAD, engine requires additional service before continuing

Idle mixture test. Read CO and HC meter at idle RPM

Measured ______%CO ______PPM HC ☐ ☐

idle speed ________RPM

Accelerator pump tests

Light acceleration (2-3" vacuum drop) ☐ ☐
Measured ______%CO

Heavy acceleration (large drop in vacuum) ☐ ☐
Measured ______%CO

High speed mixture tests

Measured ______%CO ______PPM HC ☐ ☐

Positive crankcase vent (PCV) test

Pinch or close PCV hose or valve

Measured change in CO

______ %CO ☐ ☐

GO/NO-GO TEST

At idle RPM Measured ______ %CO ______ PPM HC

idle ______ RPM

At 2500 RPM Measured ______ %CO ______ PPM HC ☐ ☐

COMBUSTION EFFICIENCY TESTER

Idle speed

(within specification)

Spec ____________ RPM Measured ____________ ☐ ☐

Fuel mixture at idle (within specifications or:

Pre-1968 5 to 6% CO

1968 and later with air pump 3.0 to 4.5% CO

1968 and later without air pump 1 to 2% CO)

Measured ____________ ☐ ☐

Fuel mixture at 2500 RPM

(no change or a leaner mixture) Measured ____________ ☐ ☐

Accelerator pump action

(meter reads 1.0% increase in CO)

when engine is accelerated) Measured ____________ ☐ ☐

FUEL SYSTEM QUIZ

1. CO (carbon monoxide) is affected by:

   A. Fuel mixture and ignition timing.
   B. Misfiring of one or more cylinders.
   C. Choke operation and carburetor preheater controls.

2. An increase in HC as the idle mixture is leaned out indicates:

   A. Bad spark plugs or spark plug wires.
   B. Improper timing.
   C. Mixture is too lean.
   D. Choke is sticking.

3. Proper accelerator pump action should show an enrichment of:

   A. 3.0% CO.
   B. No change.
   C. 1.0% CO.
   D. .01% CO.

4. When the PCV valve is pinched closed the:

   A. % CO will drop.
   B. % CO will increase.
   C. HC will drop to zero.
   D. CO will drop to zero.

5. An increase in CO will always be followed by:

   A. A decrease in HC.
   B. An increase in HC.
   C. No change in HC.
   D. None of these.

6. Fuel injected engines at 2500 RPM under "no load conditions" will always:

   A. Have low CO, high HC.
   B. Have high CO, low HC.
   C. No change in HC or CO.
   D. None of these.

7. Valid fuel pump pressure and volume measurements should be made within 6" of:

   A. Fuel tank.
   B. Fuel pump.
   C. Fuel line.
   D. Carburetor.

8. A restricted or crimped fuel line from the tank to the fuel pump would cause:

   A. Low pressure and low volume.
   B. High pressure and low volume.
   C. Low pressure and high volume.
   D. Low volume and no pressure change.

9. If a fuel pump specification reads one quart in one minute, it could be changed to:

   A. 1 pint in 30 seconds.
   B. 1 pint in 60 seconds.
   C. 2 quarts in 30 seconds.
   D. 4 quarts in 15 seconds.

10. Air bubbles seen in the fuel during the volume test indicates:

    A. Air leak in the tank to fuel pump line.
    B. Leaky fuel pump.
    C. Internal leak in the carburetor.
    D. A and B only.

STARTING AND CHARGING SYSTEM TESTING

The Volts-Amp Tester, Model 28, is used to quickly test starting and charging systems.

HOOKUP

Follow these steps to set up the controls and hook up the tester to the vehicle for a quick test of the starting and charging system performance.

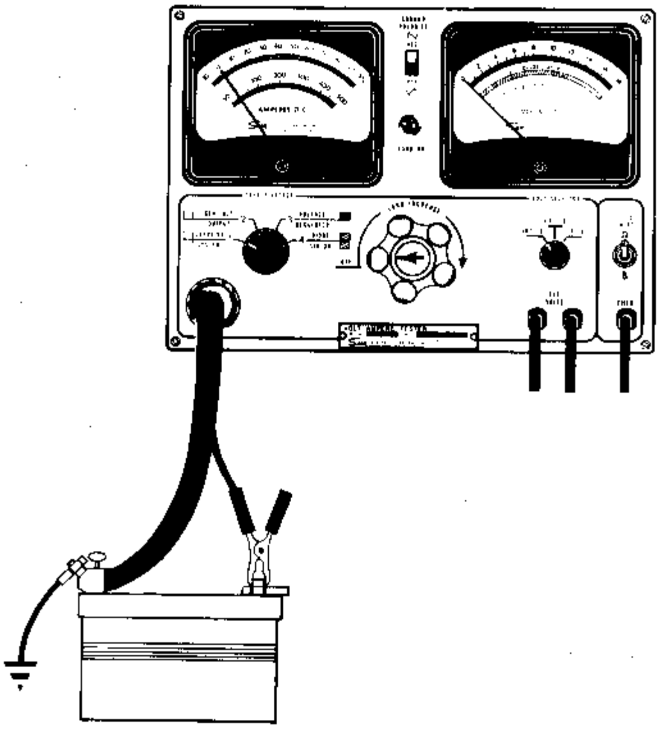
1. Set the BLACK **TEST** selector to the No. 1 position.
2. Set the BLUE **LOAD** CONTROL to "OFF".
3. Set the RED VOLT selector to knob to Int. 18.
4. Set the Black GROUND POLARITY Switch to negative for negative ground vehicles, positive for positive ground vehicles.
5. Connect the tester harness to the ground terminal of battery.
6. Slip the ground cable over the post on the tester harness. Make sure all connections are hand tight.
7. Clip the red lead to the insulated terminal of battery.
8. Ground the coil high tension lead so the engine will not start.

AREA TESTS

BATTERY PERFORMANCE UNDER LOAD

Make this test to determine if a battery state of charge is sufficient to supply enough voltage to start an engine under adverse conditions.

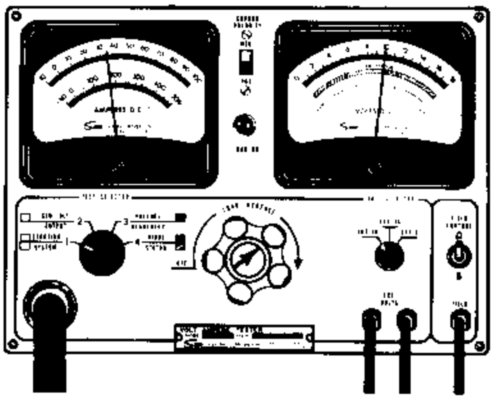
1. Determine the battery's amp-hour rating.
2. Multiply this value by 3 to determine amount of electrical draw (load) to be applied to battery.
3. Turn the Blue load control until the Red ammeter scale reads 3 times battery's amp-hour rating as determined in step 2.
4. Hold this load for 15 seconds and note Green voltmeter reading, then turn load control to OFF.



VAT-28

NOTES:

1. Engine will not start in either the No. 3 or No. 4 test position.
2. Do not leave the tester leads connected to the battery with the tester in either the No. 3 or No. 4 positions for periods longer than 15 minutes.
3. Do not operate an engine with the output lead of an alternator or AC generator disconnected or without a battery connected in the circuit.



GOOD Voltmeter remains above 9.6 volts or above specification for "CRANKING VOLTAGE"

BAD Voltage that drops below the minimum value during testing indicates the battery does not have sufficient stored energy for good starting.

a. Test the battery independently following the Sun 3-minute battery test procedure to determine its condition.

b. Check the charging system to determine if it is working properly to maintain the battery's charge.

STARTING SYSTEM TESTING

Make this test to determine if the vehicle's starting system has any problems which might affect the ability of the engine to start.

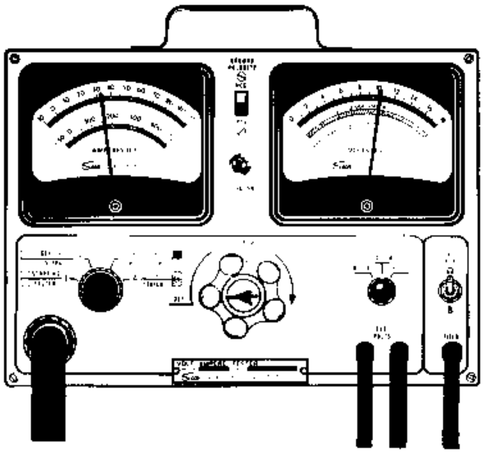
1. Crank the engine and record the Green voltmeter and the Red Ammeter readings. Note cranking speed.

GOOD Voltmeter reads above 9.6 volts or specified "CRANKING VOLTAGE" during the test. Ammeter reads less than specified or:

less than 160 amps on 6 cylinder engines.

less than 200 amps on V8's other than G. M.

less than 250 amps on V8's G. M. only.

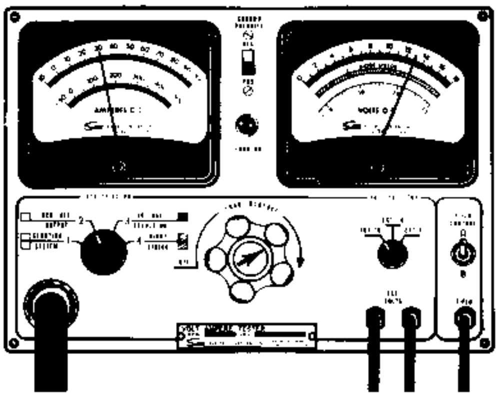


BAD Low cranking voltage and high cranking current indicates:

1. Weak battery, or a defective or binding starter or starter drive or poor lead connections or bad contacts in starter solenoid.
2. Binding in starter or starter drive, engine will also crank slowly and unevenly.

ALTERNATOR/GENERATOR OUTPUT TEST

Make this test to determine if the charging system can supply sufficient current to operate the vehicle and recharge the battery.



1. Turn the ignition switch ON.
2. Read the Red ammeter scale.

This is the "ignition on" current that runs the ignition system, powers the alternator's field windings and any other circuits that are energized at this time, such as ventilation blowers.

3. Reconnect the coil wire, start the engine and set the speed to approximately 2000 RPM.

4. Move the Black TEST SELECTOR to the No. 2 position.

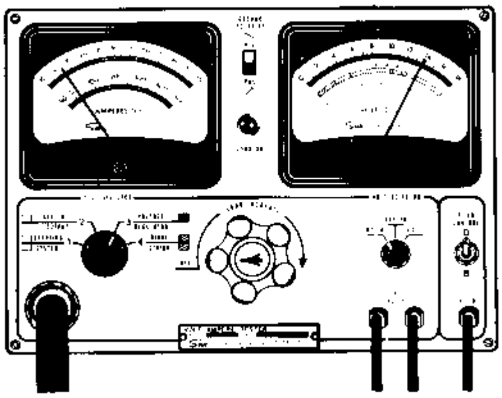
5. Turn the Blue load control slowly until the ammeter reads the highest value on the Blue scale. Record this reading, and turn the Blue load control to OFF.

GOOD ALTERNATORS The total output is the sum of the reading obtained in step No. 5 and the ignition current recorded in step No. 2. This total should be equal to or above the specified output.

DC GENERATORS The output obtained in step No. 5 should be equal to the manufacturers specified output.

BAD ALTERNATORS Low output indicates such problems as loose drive belts, defective alternator or regulator, or excessive circuit resistance. Check the belt tension. Follow the "Generator Output Using Field Control" test procedure to pinpoint the problem area.

GENERATORS Low output indicates such problems as loose drive belts, defective generator or regulator or excessive circuit resistance. Check the belt tension. Follow the "Generator Output Using Field Control" test procedure to pinpoint the problem area.



VOLTAGE REGULATOR TEST

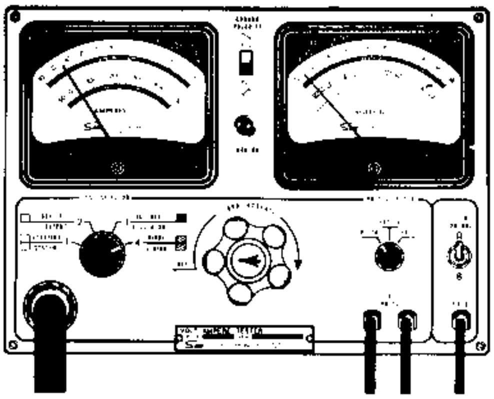
Make this test to determine if the voltage regulator limits the charging system voltage to the specified level.

1. Set the Black TEST SELECTOR to No. 3 position.
2. With the engine at idle RPM, turn the Blue load control until the Green voltmeter reads approximately 6 volts. Quickly move the load control back to OFF. This cycles the voltage regulator for more accuracy in the test results.
3. Increase the engine speed to the specified RPM. If not specified, run the test at 2000 RPM.
4. Note Green voltmeter reading.

GOOD Voltmeter reads within specifications.

BAD Low voltage indicates problems with the alternator or generator's output, improper setting of the voltage limiter in the regulator or excessive circuit resistance in the charging circuit. High voltage indicates problems with the voltage limiter or a bad ground connection in the regulator.

DIODE STATOR TEST



Make this test to determine if the diodes and stator windings in the alternator are working properly or, in DC generators, to determine if the brushes are making good contact with the armature.

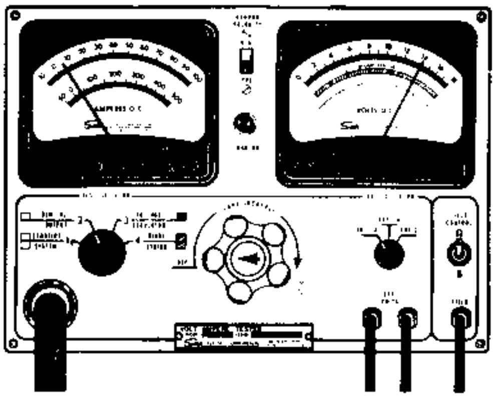
1. Set the Black TEST SELECTOR to the No.4 position.
2. Increase the engine speed to approximately 2000 RPM.
3. Read the center scale on the VOLTMETER. This scale has Green and Red slashes marked OK and REPLACE.

   GOOD Meter reads in Green area.

   BAD Alternators: A reading any place in the Red area indicates problems in either the diodes or stator windings. Alternator should be disassembled and components bench tested to pinpoint problems.

   DC Generators: A reading in red indicates poor brush to armature contact-Inspect brushes for wear.

BATTERY DRAIN TEST



Make this test to determine if there is any circuit in the car which stays on and is running down the battery when the car is parked.

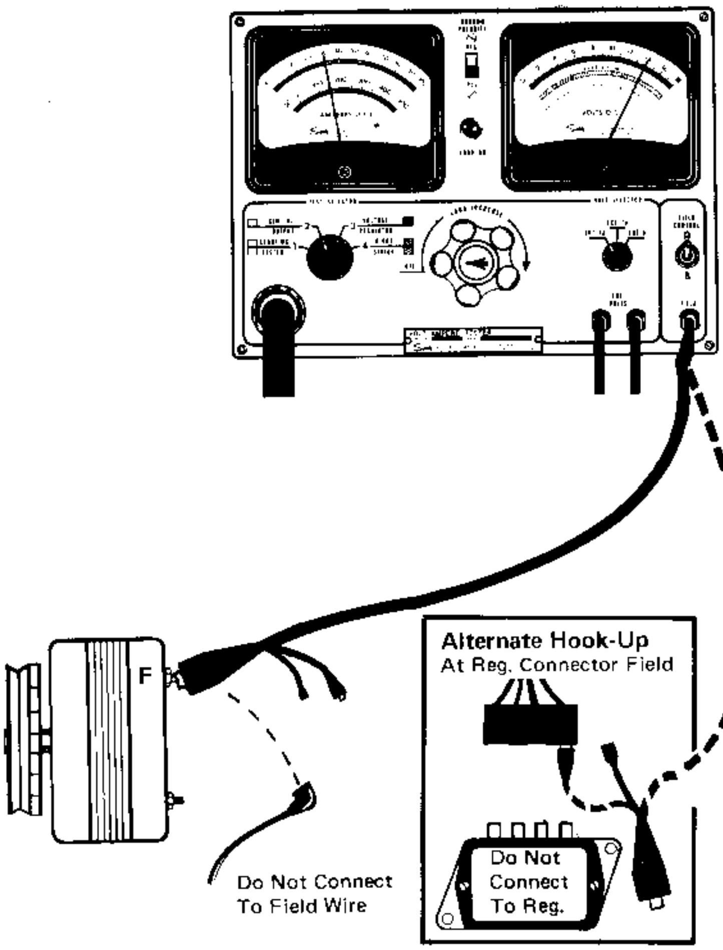
1. Stop the engine and turn off the key.
2. Turn off all the accessories and close the doors.
3. Move the Black TEST SELECTOR to the No. 2 position.
4. Record the reading on the Blue ammeter scale.

   GOOD Ammeter reads zero.

   BAD Any reading indicates a current flow which will run down the battery in time. Pinpoint the cause by removing fuses one by one and noting the ammeter. When the ammeter goes to zero check the wiring in the circuits that the last fuse removed protected.

GENERATOR OUTPUT USING FIELD CONTROL

Make this test only if alternator/generator output test is bad. During this test the alternator or generator will be controlled to produce its maximum output without using the vehicle's voltage regulator. Testing the system this way eliminates any regulator problems and allows a quick determination of the alternator or generator condition. If the alternator or generator passes this test the problem is in the regulator or its circuitry. Failure, indicates the problem is in the alternator or generator.



TESTING ALTERNATORS

1. Stop the engine.
2. Disconnect the field lead from the alternator, at either the alternator or at the regulator.
3. Connect Blue FIELD Lead to the field terminal on the alternator or to the plug at the regulator.
4. Start the engine and increase the speed to 2000 RPM or specified test speed.
5. Read the Blue ammeter scale. Do not exceed 16 volts on the GREEN voltmeter scale during this test.
   a. If the ammeter read zero, move the Field control to the B position and read the Blue ammeter scale.

RESULTS If the alternator output is within 5 amps of specifications then the problem is in the regulator or its wiring.

If the alternator output is low or zero in both A and B test positions this indicates the problems are inside the alternator. Remove and bench test the alternator.

TESTING DC GENERATORS

Determine if the generator has an A or B type field circuit.

A CIRCUIT Field windings of generator are grounded in the regulator. Examples, most generators are A circuit.

If in doubt if generator is an A or B circuit, test as an A circuit. If output is zero, then test as a B circuit.

B CIRCUIT Field windings of generator are grounded in generator. Example, Ford and most AUTOLITE generators.

1. Stop the engine.

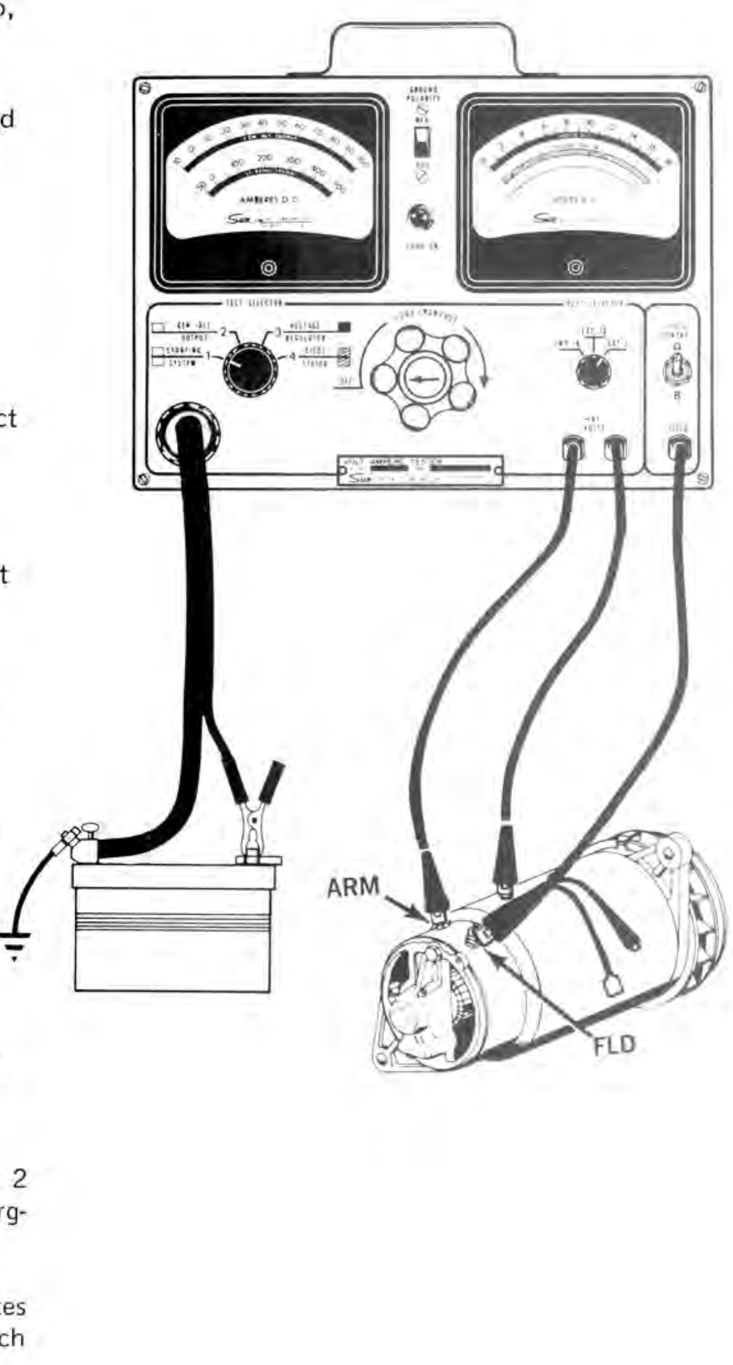
2. Connections:

"A" CIRCUIT GENERATORS

Disconnect the field lead at the generator and connect the tester's Blue Field lead to the field terminal

"B" CIRCUIT GENERATORS

Disconnect the field lead at the regulator and connect it to the armature terminal of the regulator.



3. Move the Red VOLTMETER knob to the EXT. 18 position.

4. Connect the VOLTMETER leads Red lead to the generator's armature terminal and the Black lead to a ground.

5. Start the engine and slowly increase the speed to 2000 RPM or to the specified test speed. Watch the GREEN voltmeter scale.

   DO NOT increase the engine speed above a voltmeter reading of 16V. Record the Blue ammeter scale reading.

   RESULTS If the generator output is within 2 amps of specification, then the problem in the charging system is in the regulator or its wiring.

   If the generator output is low or zero, this indicates the problem is in the generator. Remove and bench test the unit.

NAME ____________________

DATE ____________________

STARTING AND CHARGING SYSTEM TESTING WORKSHEET

Eng. No. ____________________ Make/Year ______________

GOOD BAD

BATTERY PERFORMANCE LOAD TEST

(3X Amp Hour or 1/2 Cold Cranking Current at 0° F)
(voltage remains above 9.6 volts)

Measured ______________ ☐ ☐

STARTING SYSTEM TESTS

(cranking voltage within specifications or above 9.6)

Spec ______________ volts Measured ______________ ☐ ☐

(starter draw within specifications or not more than:
160 amps for 6 cylinder engines
250 amps for V8's except GM
250 amps for GM V8's)

Spec ______________ amps Measured ______________ ☐ ☐

ALTERNATOR-GENERATOR OUTPUT TEST

(alternators – within manufacturer's specifications
generators – within manufacturer's specifications)

Spec ______________ amps Measured ______________ ☐ ☐

If BAD: OUTPUT TEST USING FIELD CONTROL
(alternators within manufacturer's specifications,
generators within manufacturer's specifications)

Spec ______________ amps Measured ______________ amps ☐ ☐

VOLTAGE REGULATOR TEST

(within specifications)

Spec ______________ volts Measured ______________ ☐ ☐

DIODE STATOR TEST

(within Blue area on scale)

Measured Blue area/Red area ☐ ☐

BATTERY DRAIN TEST

(no current flow indicated)

Measured ______________ ☐ ☐

NAME
COMPANY
CITY
TITLE

SUN ELECTRIC CORPORATION
ENGINE PERFORMANCE COURSE

SESSION 1 INTRODUCTION AUTOMOTIVE engine system and service quiz SERVICE CONTROL SYSTEM and procedures for handling customer engine service requests Use of specifications and their meaning Use of Tachometer and Dwell meter	COMMENTS
SESSION 2 COMPRESSION FACTORS Importance of compression factor testing Use of vacuum gauge Use of cylinder balance testing Use of compression tester Use of cylinder leakage tester	COMMENTS
SESSION 3 IGNITION SYSTEM TESTING Importance of primary and secondary ignition system testing for good engine performance Ignition system theory Use of the voltmeter, ammeter, ohmmeter, condenser tester, and coil tester	COMMENTS
SESSION 4 DISTRIBUTOR TESTING Importance of distributor testing Use of distributor machine to test Condensers, Contact points Mechanical components, Mechanical advance Vacuum advance Re-installing distributors Use of Timing Light and Timing Advance unit 	COMMENTS

SESSION 5 INTRODUCTION TO THE SUN SCOPE Importance of scope testing Development of the scope pattern Use of the scope to evaluate ignition systems	COMMENTS
SESSION 6 USING THE SUN SCOPE IN ENGINE TESTING Importance and value of systematic testing with the Sun Scope Practical scope testing problems Use of the scope in primary ignition testing	COMMENTS
SESSION 7 FUEL SYSTEM TESTING INTRODUCTION TO THE FUEL SYSTEM Use of fuel pump tester Use of combustion efficiency tester Introduction to exhaust emission controls	COMMENTS
SESSION 8 STARTING AND CHARGING SYSTEM TESTING COURSE REVIEW INTRODUCTION TO STARTING AND CHARGING SYSTEM TESTING Using the VAT 28 TESTER Review of SERVICE CONTROL procedures and systems Practical testing of engines	COMMENTS

GENERAL COMMENTS:

TROUBLE SHOOTING GUIDE

Refer to this trouble shooting guide when you have a "BAD" condition on the COMPLETE ENGINE PERFORMANCE TEST PROCEDURE. Here you'll find a list of components and systems which may be the cause of the condition your testing uncovered. This is followed by a list of detail tests which can help you pinpoint exactly what service is required.

For example: You have an engine with an uneven cranking vacuum. Referring to the trouble shooting guide you find that this could be caused by problems in the valves, rings, headgasket, or a cracked cylinder head or block. The guide suggests that you run a cylinder leakage test or a compression test to pinpoint the cause of the "BAD" cranking vacuum.

TEST	POSSIBLE PROBLEM AREAS	SUGGESTED DETAIL TESTS
CRANKING VOLTAGE	Battery Battery cables Starter solenoid Starter	Use the VAT-28 to test the Starting and Charging system.
CRANKING COIL OUTPUT	Bypass circuit	Use the voltmeter to measure battery voltage during cranking.
	Dwell angle	Check the dwell angle during cranking with the dwell meter.
	Coil	Check with the coil tester.
	Condenser	Check with the condenser tester.
CRANKING VACUUM	Valves Rings Headgasket Crack in head or block	Use the cylinder leakage tester and compression tester.
PCV	PCV valve PCV hose	Visually inspect system.
IDLE SPEED	Idle speed screw	Adjust to specification.
DWELLMETER	Contact points	Visually inspect and if good adjust to specification.

TEST	POSSIBLE PROBLEM AREAS	SUGGESTED DETAIL TESTS
INITIAL TIMING	Distributor	Adjust to specifications.
FUEL MIXTURE	Carburetor	Adjust to specifications after testing ignition and compression systems for proper operation.
	Intake Manifold	Test for leaks
MANIFOLD VACUUM (IDLE)	Carburetor	Adjust to specifications after testing compression and ignition systems for proper operation.
	Mechanical problems	Use the cylinder leakage and compression testers.
DWELL VARIATION	Distributor	Remove and completely test in a distributor tester.
COIL POLARITY	Coil lead connections	Visually inspect leads.
	Internal coil connections	Check polarity with the coil tester.
	Polarity of battery or generator	Check with the voltmeter.
SPARK PLUG FIRING VOLTAGE	Spark plugs or plug wires	Use grounding probe to pinpoint problem area.
	Spark plugs	Check for proper gap.
	Spark plug wires	Check for opens with ohmmeter.
	Distributor towers	Visually check for corrosion
	Rotor	Check with the ohmmeter and visually for burning of tip.
	Coil wire	Check for opens with the ohmmeter.
MAXIMUM COIL OUTPUT	Dwell angle	Check with the dwell meter
	Coil	Check with the coil tester.
	Condenser	Check with condenser tester.
	Excessive resistance in primary circuit	Check primary current with an ammeter.

TEST	POSSIBLE PROBLEM AREAS	SUGGESTED DETAIL TESTS
SECONDARY CIRCUIT INSULATION	Plug wires Distributor cap Rotor	Visually inspect all secondary circuit components.
SECONDARY CIRCUIT CONDITION	Plugs Plug wires Distributor Cap Rotor Coil Wire	Use ohmmeter, grounding probe and visual inspection to isolate problems.
COIL AND CONDENSER	Coil	Check with the coil tester.
	Condenser	Check with the condenser tester.
	Primary circuit	Check for loose connections.
BREAKER POINT CONDITION	Contact points	Visually inspect for pitting or burning. Test through entire operating range on a distributor tester.
	Condenser	Check with the condenser tester.
CAM LOBE ACCURACY	Distributor	Test for worn cam lobes or bent distributor-shaft or worn bearings on a distributor tester.
	Engine conditions affecting distributor	Test distributor on a distributor tester to be sure it is not the problem.
FUEL MIXTURE (1000 RPM)	Carburetor	Check carburetor. Clean or overhaul as required.

TEST	POSSIBLE PROBLEM AREAS	SUGGESTED DETAIL TESTS
CYLINDER POWER BALANCE	Ignition	Check the operation of the ignition system with the scope.
	Compression system	Check compression factors with vacuum gauge and if bad, test with the cylinder leakage and compression testers.
	Fuel system	Check the mixture with emission tester. Visually inspect for intake manifold leaks.
SPARK PLUGS UNDER LOAD	Spark plugs	Check for proper gap.
ACCELERATOR PUMP ACTION	Carburetor	Visually inspect linkage. Clean or overhaul as required.
TIMING ADVANCE	Distributor	Timing advance unit may be used to pinpoint problem area. Remove distributor and completely test in a distributor tester.
CHARGING VOLTAGE	Generator	Use the VAT-28 to test the starting and charging system.
	Regulator	
	Wiring	
FUEL MIXTURE (2500 RPM)	Carburetor	Check carburetor visually. Clean or overhaul as required.
EXHAUST RESTRICTION	Exhaust system	Visually inspect system for restrictions.

Complete Engine Performance Troubleshooting Worksheet

	TEST PROCEDURE	READ	SPECS.	RESULTS	GOOD	BAD
START	**Cranking Voltage**	Voltmeter				
	Cranking Coil Output	Scope (Display)				
	Cranking Vacuum	Vacuum Gauge				
	PCV Test	Vacuum Gauge				
IDLE	**Idle Speed**	Tachometer				
	Dwell	Dwell-Meter				
	Initial Timing	Timing Advance Unit				
	Fuel Mixture	Combustion Eff. Tester				
	Manifold Vacuum	Vacuum Gauge				
CRUISE	**Dwell Variation**	Dwell Meter				
	Coil Polarity	Scope (Display)				
	Spark Plug Firing Voltage	Scope (Display)				
	Maximum Coil Output	Scope (Display)				
	Secondary Circuit Insulation	Scope (Display)				
	Secondary Circuit Condition	Scope (Raster)				
	Coil and Condenser Condition	Scope (Raster)				
	Breaker Point Condition	Scope (Raster)				
	Cam Lobe Accuracy	Scope (Superimposed)				
	Fuel Mixture	Combustion Eff. Tester				
	Cylinder Power Balance	Tachometer	▨	▨		
	Record RPM	1 2 3	4	5 6	7	8
ACCELERATION	**Spark Plugs Under Load**	Scope (Display)				
	Accelerator Pump Action	Combustion Eff. Tester				
HIGH SPEED	**Timing Advance**	Timing Advance Unit				
	Charging Voltage	Voltmeter				
	Fuel Mixture	Combustion Eff. Tester				
	Exhaust Restriction	Vacuum Gauge				